Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Wireless Telecommunications Bureau	)	WT Docket No. 18-203
Seeks Comment on the State of Mobile	)	
Wireless Competition	)	

COMMENTS OF CTIA

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EXECUTIVE SUMMARY

The wireless market in the United States is vibrant, innovative, and highly competitive. Consumers today have unparalleled choice among wireless providers, services, plans, and devices. For reasons discussed in detail in these Comments, CTIA urges the Commission to reaffirm its conclusion and report to Congress that competition in the provision of mobile wireless services is effective.

By any metric, the mobile wireless marketplace is robust and thriving. By way of just a few examples:

- ***Adoption.*** At the end of 2017, there were 400.2 million wireless subscriber connections—approximately 1.2 active wireless devices for every person in the U.S. Smartphones alone accounted for 273.2 million of these devices, and when combined with tablets, laptops, and wireless modems, these heavy data traffic-generating devices collectively represented 83 percent of all reported devices. Significantly, 2017 saw an increase of 19.5 percent in data-only devices, reaching 126.4 million, reflecting the rapid growth of the Internet-of-*Mobile*-Things.
- ***Usage.*** Average data usage has increased dramatically over the past year. Monthly traffic per smartphone jumped from 3.9 GB to 5.1 GB, an astounding 30.7 percent increase for a single year. Americans used 15.7 trillion MB in 2016—40 times more mobile data than in 2010—and data usage is projected to increase five-fold from 2016 to 2021.
- ***Investment.*** Wireless carriers invested approximately $25.6 billion in capital expenditures in 2017. Over the past eight years, wireless providers spent more than $229.5 billion in network improvements to deliver 4G LTE mobile broadband, and industry is expected to invest $275 billion to build out their 5G networks over the next decade.
- ***Deployment.*** 4G LTE service is now available to at least 99.7 percent of Americans and covers more than 73 percent of the total U.S. land area. That connectivity is enabled by the 323,448 cell sites that are now deployed throughout the country. The deployment of small cells, which helps satisfy consumers' data demands and provides an important network densification precursor for 5G, is expected to see a skyrocketing increase of 550 percent in 2018.

There is no question that consumers benefit the most from this competitive landscape. Competition is driving innovation and pushing wireless providers to deliver greater value to a broad range of consumers in both urban and rural areas, creating flexible options and

dramatically improving consumers' lifestyles. To stay competitive, wireless providers, including new entrants such as traditional cable providers, are upgrading their networks, expanding service to new locations, and taking effective measures to protect network, device, and consumer data, privacy, and security. Wireless providers value the privacy and security of their customers and have implemented a range of measures to ensure the security of their customers' devices, accounts, data, and personal information, as well as their personal safety. The competitive marketplace for mobile broadband services ensures that providers will continue to develop new and better practices to meet their customers' expectations.

Consumers are leading a mobile-first lifestyle. Consumers increasingly use their wireless devices to make daily tasks easier and to access information about employment opportunities, news, healthcare, transportation, public safety, entrepreneurship, and education. Large increases in smartphone data consumption and adoption of Internet of Things ("IoT") devices are indicative of the strong demand for high-quality wireless broadband services that enable better ways for consumers to work, learn, and play.

Consumers of all incomes and abilities are able to participate in the mobile-first lifestyle. Wireless providers, device manufacturers, and app developers are all competing hard to offer services and products that meet the needs of every consumer. Diverse populations—including value-conscious consumers, the accessibility community, senior citizens, military veterans, and frequent international travelers—all now have a range of offerings to suit their needs.

Consumers are obtaining greater value from their services. Strong competition has prompted carriers to develop new, creative ways to attract and retain customers, and customers are enjoying more and higher quality services and devices as a result.

The wireless industry continues to be a tremendous job creator. Approximately 4.7 million jobs rely directly or indirectly on the wireless industry—including, for instance, jobs working for wireless operators, in device and accessories manufacturing, for professional services organizations, and in mobile advertising. The wireless industry also contributes billions of dollars to the U.S. economy—more than $475 billion annually, with nearly half of that through adjacent industries such as semiconductor manufacturing. And each $1 of the wireless industry's direct GDP contribution results in $3.21 of total GDP impact across the American economy.

The wireless industry, including the IoT segment, is increasingly robust. Wireless devices, connections, and traffic are growing exponentially, with 90 percent of new net wireless connection adds in the first quarter of 2018 coming from data-only devices such as connected cars and IoT devices. This trend is expected to continue, as new use cases result in the number of IoT devices growing approximately 20 percent per year.

Wireless is helping to close the digital divide. Last year, approximately 84.2 percent of the rural population was covered by at least three LTE service providers—a 3.6 percentage point increase from 2016. Rural and regional carriers have also begun testing 5G services, with a focus on addressing the challenges unique to serving rural areas.

The industry has welcomed new entrants since the Commission's last report on the state of the mobile wireless marketplace. Multiple new entrants, including cable operators and satellite companies, are poised to compete aggressively in the wireless market, including in the roll-out of the next generation of wireless, 5G.

5G networks will deliver better connectivity by every metric. 5G technology will enable wireless networks to serve users with speeds that are up to 100 times faster than 4G networks

along with better scalability, lower latency, and higher reliability. The improved connectivity of 5G will also create a platform for applications and devices that will drive radical improvements in how we communicate, travel, learn, and receive medical care.

In addition, while CTIA applauds recent Commission efforts to reduce regulatory barriers and harmonize rules across license services, CTIA proposes a number of steps that the Commission should take that will further reduce barriers to entry, promote competition, and accelerate United States leadership in the race to 5G. First, the Commission should continue its efforts to modernize the rules governing the infrastructure siting process in order to reduce both costs and deployment times, updates that are crucial for the mass deployment of small cells required by 5G. The Commission should also continue to make available low-, mid-, and high-band spectrum for licensed use to enable continued investment and innovation by wireless providers.

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COMMENTS OF CTIA

CTIA[1] respectfully submits these comments in response to the *Public Notice* released by the Wireless Telecommunications Bureau ("Bureau") of the Federal Communications Commission ("Commission") in the above-captioned proceeding.[2] The RAY BAUM'S Act of 2018 amends the Communications Act of 1934 ("the Act") and requires that the Commission publish a biennial "Communications Marketplace Report," that, *inter alia*, "assess[es] the state of competition in the communications marketplace."[3] By its *Public Notice*, the Bureau "seeks input on the state of mobile wireless competition as it would relate to the overall goal of providing the required Report to Congress on the state of the communications marketplace."[4]

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[1] CTIA® (www.ctia.org) represents the U.S. wireless communications industry and the companies throughout the mobile ecosystem that enable Americans to lead a 21st century connected life. The association's members include wireless carriers, device manufacturers, suppliers as well as apps and content companies. CTIA vigorously advocates at all levels of government for policies that foster continued wireless innovation and investment. The association also coordinates the industry's voluntary best practices, hosts educational events that promote the wireless industry and co-produces the industry's leading wireless tradeshow. CTIA was founded in 1984 and is based in Washington, D.C.

[2] *Wireless Telecommunications Bureau Seeks Comment on the State of Mobile Wireless Competition*, Public Notice, DA 18-663, WT Docket No. 18-203 (rel. June 26, 2018) ("*Public Notice*").

[3] Consolidated Appropriations Act, 2018, Pub. L. No. 115-141, Div. P—RAY BAUM'S Act of 2018, §§ 401-404, 132 Stat. 348, 1087-90, Div. P—RAY BAUM'S Act of 2018, Title IV: FCC Consolidated Reporting, Section 13 (2018) ("RAY BAUM'S Act of 2018"). This report will include information that was previously submitted to Congress as a separate Mobile Wireless Competition Report under Section 332(c)(1)(C) of the Act. *See* 47 U.S.C. § 332(c)(1)(C).

[4] *Public Notice*.

Among other things, the *Public Notice* seeks input on "whether laws, regulations, regulatory practices or demonstrated marketplace practices pose a barrier to competitive entry into the mobile wireless marketplace, or to the competitive expansion of existing providers."[5]

As discussed in more detail below, competition in the mobile wireless marketplace is extraordinarily robust and growing, as the Commission appropriately recognized in its *Twentieth Report* on the state of mobile wireless competition.[6] The wireless market displays vibrant competition along every relevant dimension, including expanded service coverage and offerings, the continuous deployment of new technologies, and new entry by well-capitalized competitors—to the benefit of American consumers, businesses, and the U.S. economy. Accordingly, CTIA urges the Commission to reaffirm its conclusion and report to Congress that competition in the provision of mobile wireless services is effective.

I. INTRODUCTION.

The mobile wireless market in the United States is vibrant, innovative, and highly competitive. Consumers today have unparalleled choice among wireless providers, services, plans, and devices. By any metric—adoption, usage, investment, deployment—the mobile wireless marketplace is robust and thriving. And consumers are reaping the benefits. Competition is pushing wireless providers to deliver greater value to consumers, creating flexible options and enabling a mobile-first lifestyle. To stay competitive, wireless providers, including new entrants such as traditional cable providers and satellite providers, are upgrading their networks, expanding service to new locations, and taking effective measures to protect

[5] *Id*. at 1.

[6] *See Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Twentieth Report, 32 FCC Rcd 8968 (2017) ("*Twentieth Report*").

consumers' data, privacy, security, and devices. Wireless providers are helping close the digital divide, not just with respect to rural areas, but also by enabling consumers across demographics, incomes, and abilities to enjoy the benefits of mobile wireless connectivity.

Competition creates jobs and fuels innovation, as evidenced by the burgeoning Internet of Things ("IoT") segment. And this is only the beginning. With providers racing to deploy 5G networks with speeds that are up to 100 times faster than 4G networks, we can expect to see an explosion of applications and devices that will drive radical improvements in how we communicate, travel, learn, and receive medical care.

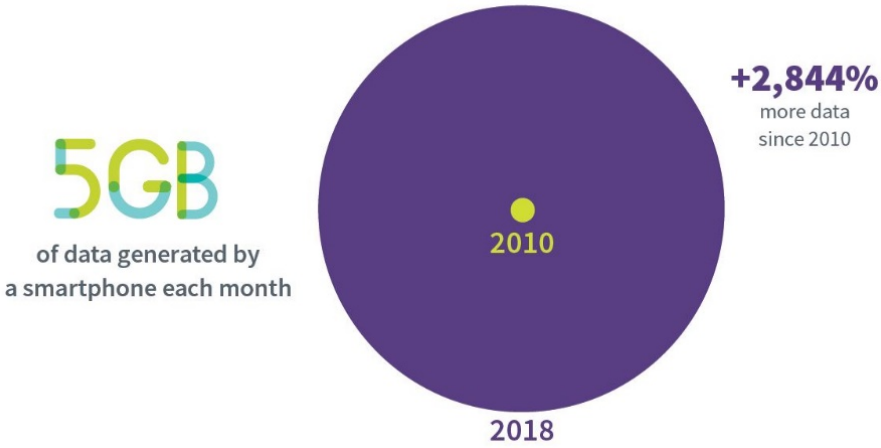
For these and other reasons discussed in these Comments, CTIA urges the Commission to reaffirm its conclusion and report to Congress that competition in the provision of mobile wireless services is effective. In addition, CTIA proposes a number of steps that the Commission should take that will reduce barriers to entry, promote competition, and accelerate the United States' position in the race to 5G. Specifically, the Commission should continue its efforts to modernize the rules governing the infrastructure siting process in order to reduce both costs and deployment times—steps that are crucial for the mass deployment of small cells required to densify 4G LTE networks and support 5G. In addition, the Commission should continue to make available spectrum for licensed, terrestrial use to enable continued investment and innovation by wireless providers.

II. COMPETITION IN THE WIRELESS MARKETPLACE IS BRINGING MYRIAD BENEFITS TO CONSUMERS AND TO THE U.S. ECONOMY.

Driven by the need to deliver high-quality services for consumers with diverse needs, income levels, and abilities, wireless providers continue to innovate, delivering greater value to consumers and supporting their mobile-first lifestyle.

A. Today's Consumers Lead a Mobile-First Lifestyle.

Consumers increasingly use their wireless devices to make daily tasks easier and to access information, including information regarding employment opportunities, news, healthcare, transportation, public safety, entrepreneurship, and education. Over half of users also use their mobile device to shop, share photos, check the weather, and manage their finances.[7] Mobile devices support users' love for social media, enabling them to download terabytes of data, tweet millions of messages, and exchange content and commentary instantaneously. On average, consumers spend 177 minutes on their phone each day,[8] scrolling and swiping through applications and content in between other tasks about 150 times a day.[9]



Consumption of mobile video and live streaming also continues to grow at a staggering pace: more than 112 million consumers watched video on their tablets and more than 160 million watched video on their mobile phones in 2017.[10] Significantly, those figures are expected to

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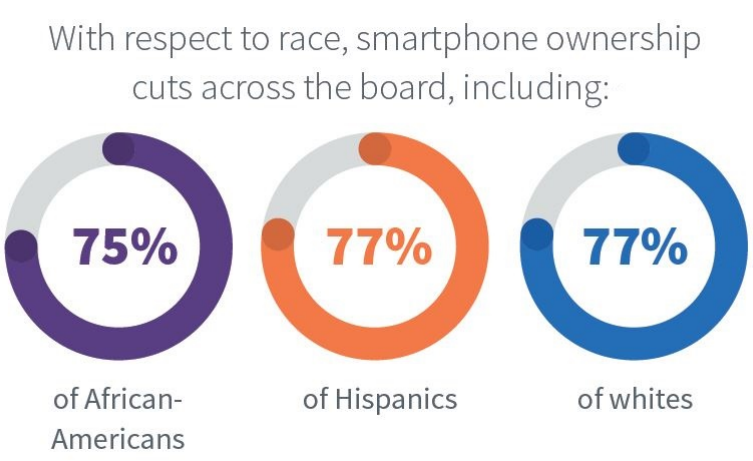
[7] *See Leading Mobile-first Online Activities as of 2nd Quarter 2017*, STATISTA (last visited July 19, 2018), https://www.statista.com/statistics/783357/leading-mobile-first-activities/.

[8] *See* Brian Solis, *Customers Are Increasingly Mobile-First, Yet Mobile Websites Are Sending Visitors Away*, FORBES (Mar. 22, 2018), https://www.forbes.com/sites/briansolis/2018/03/22/customers-are-increasingly-mobile-first-yet-mobile-websites-are-sending-visitors-away/#42abb9d73e32.

[9] *Id.*

[10] *See Number of Mobile Phone Video Viewers in the United States from 2014 to 2020*, STATISTA, https://www.statista.com/statistics/209348/mobile-video-viewers-in-the-united-states/ (last visited July



grow to more than 124 million and almost 180 million by 2020, respectively.[11] And consumers watched more than an hour of video across mobile devices every day.[12] On average last year, a smartphone generated more than 5 GB of data every month.[13] Given how much consumers rely on their mobile devices, it is no surprise that more Americans would choose their mobile phone over chocolate (80 percent), dating (70 percent), beer (84 percent), and coffee (69 percent).[14]

Consistent with these statistics, a staggering 95 percent of Americans now own a mobile device of some kind,[15] and smartphone adoption is up across demographics.[16] In fact, the share

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23,2018); *Number of Tablet Video Viewers in the United States from 2013 to 2020*, STATISTA, https://www.statista.com/statistics/298410/us-tablet-video-viewers/ (last visited July 23, 2018).

[11] *Id.*

[12] *See Average Daily Time Spent with Digital Video Content Among Adults in the United States from 2012 to 2017, by Device (in minutes)*, STATISTA, https://www.statista.com/statistics/420799/daily-digital-video-content-consumption-usa-device/ (last visited July 18, 2018).

[13] *CTIA Wireless Industry Indices Report* (2018); *see also* Colin Dixon, *Wireless Data Usage Hits 5 GB a Month, Driven by Video*, NSCREEN MEDIA (July 10, 2018), http://www.nscreenmedia.com/mobile-video-drives-4x-growth-wireless-data/.

[14] *See The State of Wireless 2018*, CTIA, at 9 (July 10, 2018), https://www.ctia.org/news/the-state-of-wireless-2018 ("*The State of Wireless 2018*") (citing Morning Consult survey: nationwide poll of 1,991 registered voters between Jan 30 and Feb 1, 2018).

[15] *See Mobile Fact Sheet*, PEW RESEARCH CENTER: INTERNET & TECHNOLOGY (July 17, 2018), http://www.pewinternet.org/fact-sheet/mobile/ ("A substantial majority of Americans are cellphone owners across a wide range of demographic groups. By contrast, smartphone ownership exhibits greater variation based on age, household income and educational attainment.") ("*Pew Mobile Fact Sheet*").

[16] *Cf. id.*

of Americans that own smartphones is 77 percent, up from just 35 percent in Pew Research Center's first survey of smartphone ownership conducted in 2011.[17] Indeed, many consumers rely almost exclusively on their wireless connection; one in five U.S. adults is a "smartphone-only" Internet user.[18] This trend is particularly pronounced among Hispanics, African-Americans, young adults, and low-income individuals.[19]

In addition to smartphones, consumers and businesses alike are increasingly depending on other wireless devices, such as innovative IoT-connected devices and sensors. For example, the number of consumers with connected homes nearly doubled from 2015 to 2017,[20] and nearly half of the consumers that use smart home devices also own a wearable device.[21] Wireless networks will form the backbone of connected vehicles, with nearly 90 percent of vehicles projected to include at least 4G LTE connectivity by model year 2022.[22]

[17] *See id*.

[18] *Id*.

[19] *Id*.

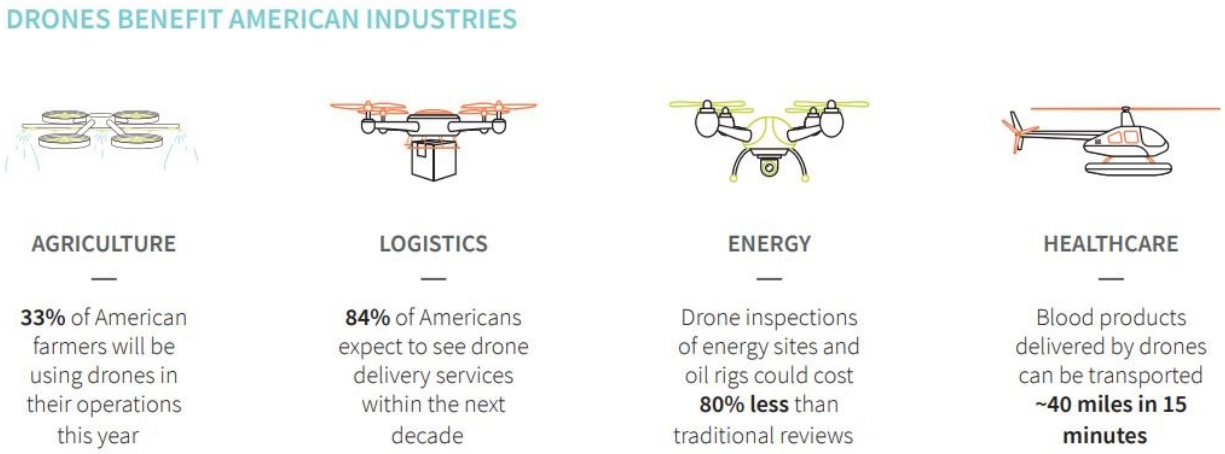
[20] *See* Kabir Ahuja and Mark Patel, *There's No Place Like [a Connected] Home*, MCKINSEY & COMPANY, https://www.mckinsey.com/spContent/connected_homes/index.html (stating that the U.S. market saw an increase in the number of connected homes from 17 million in 2015 to 29 million in 2017).

[21] *Id*.; *see* Section III.B. for a detailed discussion of the IoT's explosive growth.

[22] *See* Rene Millman, *Connected Cars Report: 125 Million Vehicles by 2022, 5G Coming* (Apr. 9, 2018), https://internetofbusiness.com/worldwide-connected-car-market-to-top-125-million-by-2022/.

Businesses are using unmanned aerial vehicles ("UAVs" or "drones") more and more to support their operations. For example, thirty-three percent of American farmers will be using drones in their operations in 2018, and drone inspections of energy sites and oil rigs could cost 80 percent less than traditional reviews.[23] Police and fire departments, such as those in National City, CA, are employing drones to assist in emergency response efforts.[24] Drones also support consumers' daily activities.[25] For instance, 84 percent of Americans expect to see drone delivery services within the next decade.[26]

These innovations—indeed, this lifestyle—would not be possible without a competitive wireless market.



[23] Ben Potter, *Poll: 33% of Farmers Flying Drones This Year*, AG WEB (Apr. 13, 2017), https://www.agweb.com/article/poll-33-of-farmers-flying-drones-this-year-naa-ben-potter; Mark Scott, *Energy Giants Turn to Drones and Sensors in New Embrace of the Digital World*, N.Y. TIMES (Nov. 3, 2016), https://www.nytimes.com/2016/11/03/business/energy-environment/energy-giants-turn-to-drones-and-sensors-in-new-embrace-of-the-digital-world.html.

[24] David Hernandez, *Drones will Supplement Fire, Police Departments in National City, Calif.*, SAN DIEGO TRIBUNE (July 17, 2018), http://www.govtech.com/public-safety/Drones-Will-Supplement-Fire-Police-Departments-in-National-City-Calif.html.

[25] *Commercial Wireless Networks: The Essential Foundation of the Drone Industry*, CTIA (Nov. 13, 2017), https://www.ctia.org/news/commercial-wireless-networks-the-essential-foundation-of-the-drone-industry-2.

[26] Office of Inspector General, United States Postal Service, Public Perception of Drone Delivery in the United States (Oct. 11, 2016), https://www.uspsoig.gov/sites/default/files/document-library-files/2016/RARC_WP-17-001.pdf.

B. The Wireless Industry is Increasingly Focused on Delivering High-Quality Services and Products to Consumers with Diverse Needs, Income Levels, and Abilities.

Faced with fierce competition from other service providers, the wireless industry works hard to deliver a host of high-quality services and products that appeal to all consumer segments, including discrete markets such as price-conscious consumers, the accessibility community, senior citizens, and military veterans.

Low-Cost and Localized Offerings. Facilities-based providers and Mobile Virtual Network Operators ("MVNOs")[27] alike offer specialized packages to certain types of users and communities, including price-conscious consumers. In addition to their core offerings, nationwide facilities-based providers offer additional plans and flexibility through their own affiliates—*e.g.*, Cricket Wireless (AT&T), Boost Mobile (Sprint), and MetroPCS (T-Mobile). Cricket Wireless and Boost Mobile, for example, offer unlimited talk, text, and data access with no annual contract, and the option to add on features such as international service, high-speed Internet access, and more.[28] MVNO TracFone also provides low-cost plans for consumers with limited cellular wireless needs and "pay-as-you-go" offerings for consumers that are looking for the flexibility to pay only for the services that they use.[29] Wireless providers also offer

[27] The Commission has not restricted itself to facilities-based carriers when assessing the competitive landscape of the wireless marketplace. *See, e.g.*, *Twentieth Report* ¶¶ 15-16.

[28] Cell Phone Plans: Unlimited Talk & Text + Data Access, Cricket Wireless, https://www.cricketwireless.com/cell-phone-plans (last visited July 19, 2018); Add-on Features, Cricket Wireless, https://www.cricketwireless.com/shop/features.html (last visited July 19, 2018); Plans, Boost Mobile, https://www.boostmobile.com/plans.html?intnav=TopNav:Plans:PhonePlans (last visited July 19, 2018).

[29] TracFone Plans, TracFone Wireless, Inc., https://www.tracfone.com/shop/plans?lang=en (last visited July 19, 2018).

affordable phone and Internet service supported by the Commission's Lifeline program for low-income consumers.[30]

Rural and regional wireless providers likewise offer service plans that are valuable to consumers with a variety of needs. Appalachian Wireless, for example, recently launched a new unlimited data plan[31] and offers unlimited talk and text with no contract at a variety of price points.[32] Bluegrass Cellular likewise offers an unlimited data plan, which includes unlimited talk, text, and data, HD video streaming, and unlimited mobile hotspots.[33] GCI's Simply Unbeatable plan offers customers the convenience of unlimited data on every line, and prices per line are reduced as additional lines are added to the account.[34] And Southern Linc's unlimited plans include unlimited regional data and messaging;[35] unlimited text and picture messaging plans are available for less than $20 per month.[36]

Accessibility. Carriers offer a number of service plans at varying rates for individuals who do not use voice minutes to communicate. For example, U.S. Cellular offers two

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[30] *See, e.g.*, Lifeline, AT&T, https://www.att.com/home-phone/lifeline.html (last visited July 19, 2018); Lifeline Program, T-Mobile, https://www.t-mobile.com/offers/lifeline-program (last visited July 19, 2018); Discounted Wireless Lifeline Program Phone Service, Verizon, https://www.verizonwireless.com/solutions-and-services/lifeline/ (last visited July 19, 2018).

[31] Unlimited Data, Appalachian Wireless, https://www.appalachianwireless.com/?page=unlimited_data (last visited July 19, 2018).

[32] Forward Pay, Appalachian Wireless, https://www.appalachianwireless.com/?page=apay (last visited July 19, 2018).

[33] Bluegrass Unlimited, Bluegrass Cellular, https://bluegrasscellular.com/shop/plans/bluegrass-unlimited (last visited July 18, 2018).

[34] Unlimited Data on Every Line!, GCI, https://www.gci.com/wireless/plans/simply%20unbeatable (last visited July 19, 2018).

[35] Service Plans, Southern Linc, https://www.southernlinc.com/service-plans/simplelinc/month-to-month.aspx (last visited July 19, 2018).

[36] Text Messaging, Picture Messaging & Web Browsing, Southern Linc, https://www.southernlinc.com/addons/texting-pictures-web.aspx (last visited July 18, 2018).

messaging-only plans starting at $30 per month, which are suited for customers with hearing and speech impairments.[37] Verizon's Nationwide Messaging Plans include plans at a range of price points with unlimited text, picture, and video messaging, designed specifically for individuals who communicate using non-voice functions.[38] AT&T also offers specialized Accessibility Plans at varying rates developed for customers who are unable to effectively communicate over voice networks.[39] These plans provide data-only network access and typically include text messaging, email, Internet access, and video calling or multimedia messaging.[40] Similarly, Sprint offers a suite of messaging services that are particularly useful for consumers who are deaf, hard of hearing, or have a speech disability.[41]

The wireless industry is also leading the rapid deployment of real-time text ("RTT") on IP-enabled networks to replace 20th century teletypewriters ("TTY") with the benefits and flexibility of 21st century communications capabilities for people who are deaf, hard of hearing, or speech impaired. RTT benefits consumers with hearing- and speech-related disabilities by providing a more conversational communications experience. The wireless industry began introducing RTT at the end of 2017 following the Commission's determination that this next-

[37] Messaging-Only Plans, U.S. Cellular, https://www.uscellular.com/plans/text-only.html (last visited July 18, 2018).

[38] Nationwide Messaging Plans, Verizon, https://www.verizonwireless.com/support/nationwide-faqs (last visited July 18, 2018).

[39] *See, e.g.*, Basic and Feature Phone Accessibility Plans, AT&T, https://www.att.com/shopcms/media/att/2016/shop/wireless/landing/disability-aging/pdf/PDF-Basic-and-feature-phone-accessibility-plans.pdf (last visited July 18, 2018).

[40] *Id.*

[41] Sprint Accessibility – Wireless, Sprint, https://www.sprint.com/en/shop/services/accessibility/wireless.html#sprint-relay-store (last visited July 18, 2018).

generation service could serve in place of antiquated wireless TTY requirements.[42] The first RTT-capable devices appeared on AT&T's, Verizon's, and T-Mobile's networks in 2017.[43] Other service providers may elect to deploy RTT in lieu of supporting wireless TTY, and wireless handset manufacturers are working to develop additional devices by the end of 2018.[44] LG, Apple, and Samsung are already working closely with nationwide wireless providers on these efforts. For instance, the LG G6, Samsung Note 8, and the iPhone X, 8 Plus, 8, 7 Plus, 7, 6 Plus, and 6, which support RTT, are each available on certain providers' networks. AT&T has also developed an over-the-top application to deploy RTT on devices on its network, including devices supporting Android 4.4 or later as well as Apple devices with iOS 9.0 or later. The wireless industry is committed to continuing its dialogue with the accessibility community to ensure that as RTT evolves, this new functionality meets users' needs.

Device manufacturers, in addition to creating RTT-enabled devices, are also working to promote accessibility in other ways. Samsung, HTC, LG, Sony, and other wireless handset manufacturers all have devices with features and functionalities that facilitate communications for people with specific accessibility needs, including features that read aloud text on the screen

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[42] *See Transition from TTY to Real-Time Text Technology et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 13568 ¶ 8 (2016) ("RTT is an effective and efficient replacement for TTY technology."). The rule amendments became effective February 22, 2017. *See Announcement of Effective Date for Real-Time Text Rules and Comment and Reply Comment Deadlines for Further Notice of Proposed Rulemaking*, Public Notice, 32 FCC Rcd 1121 (2017).

[43] *See* Accessibility Policy, T-Mobile, https://www.t-mobile.com/customers/accessibility-policy (last visited July 15, 2018); Real-time Text, Verizon, http://www.verizon.com/about/accessibility/real-time-text (last visited July 15, 2018); AT&T Real-Time Text, AT&T, https://www.att.com/esupport/article.html#!/wireless/KM1233824 (last visited July 15, 2018).

[44] *See, e.g.*, Matt Gerst and Kara Graves, *Real-Time Text is Wireless Accessibility for the 21st Century*, CTIA (Feb. 12, 2018) http://www.ctia.org/news/real-time-text-is-wireless-accessibility-for-the-21st-century; *Half a Century Later – An Alternative to TTY*, AT&T PUBLIC POLICY BLOG (Dec. 11, 2017), https://www.attpublicpolicy.com/accessibility/half-a-century-later-an-alternative-to-tty/.

and permit users to control their devices through motion gestures.[45] Apple's iPhones offer similar capabilities through their VoiceOver feature, which uses image recognition and aural descriptions to allow users with vision impairment to effectively use their devices.[46]

The next generation of wireless, 5G, is expected to further benefit the accessibility community. For instance, 5G's characteristic low latency will enable virtual and augmented reality programs to support educational and skills-training opportunities for both children and adults with cognitive and learning disabilities who may otherwise lack access to those resources because of their location. The cell-site densification and additional wireless infrastructure needed for 5G will also enhance geo-location capabilities to improve transportation opportunities and independent living for older adults, people with mobility limitations, and people who are blind or have low vision. And 5G will continue to advance home automation, which will likewise enhance independent living opportunities for people of diverse abilities.[47]

Seniors. The wireless industry also continues to offer service plans and devices designed with seniors in mind. Nationwide and rural wireless providers alike have plans specifically

[45] *See, e.g.*, Accessibility Settings on Your Phone, Samsung, https://www.samsung.com/us/support/answer/ANS00062641/ (last visited July 23, 2018); TalkBack, HTC 10, HTC, https://www.htc.com/us/support/htc-10/howto/navigating-your-phone-with-talkback.html (last visited July 23, 2018); TalkBack, Sony Mobile, https://support.sonymobile.com/globalen/xperiaz3compact/userguide/talkback/ (last visited July 23, 2018).

[46] Accessibility, Apple, https://www.apple.com/accessibility/iphone/vision/ (last visited July 23, 2018).

[47] *See, e.g.*, *id.*; Karin Willison, *7 Helpful Smart Home Devices for People with Disabilities*, THE MIGHTY (Aug. 29, 2017), https://themighty.com/2017/08/smart-home-devices-for-people-with-disabilities/. A smart home may host a myriad of features such as automated doors and lighting, automatic door openers and smart locks, many of which depend on smartphones to function.

designed for seniors, such as T-Mobile's Unlimited 55+,[48] AT&T's Senior Nation Plan,[49] and Consumer Cellular's low-cost options and AARP member discounts.[50] These plans are typically prepaid and include fewer minutes and extras (*e.g.*, music or video streaming services) than standard plans, which help seniors stay connected at a low cost and without the full suite of features and services that may go unused by seniors. U.S. Cellular also offers guidance for seniors on how to choose a phone and plan that fits their needs.[51]

Mobile devices themselves can also be specifically tailored to the needs of older adults. LG, for instance, offers EasyHome Screen on its mobile devices, with a simpler layout and larger font size. Similarly, iOS VoiceOver and Samsung Galaxy's Easy Mode are particularly helpful to seniors by reducing clutter on their phone screens and improving usability. Hundreds of devices are available from wireless handset manufacturers such as HTC, LG, Motorola, Apple, Nokia, Kyocera, and Samsung, at a variety of price points and with various additional functionalities to serve the needs of consumers.[52] The recent wave of personal assistants included in smartphones also provides additional hands-free convenience for all users of wireless devices, and greatly increases accessibility for users with vision impairments.[53]

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[48] Unlimited 55+, T-Mobile, https://www.t-mobile.com/offers/t-mobile-one-unlimited-55 (last visited May 1, 2018).

[49] Change to AT&T Senior Nation plan, AT&T, https://www.att.com/esupport/article.html#!/wireless/KM1009134 (last visited July 23, 2018).

[50] Plans, Consumer Cellular, https://www.consumercellular.com/Plans (last visited July 23, 2018).

[51] Smartphones for Seniors: Choosing the Right Phone and Plan, U.S. Cellular (Mar. 28, 2017), http://connected.uscellular.com/live-home-and-family/smartphones-seniors-choosing-right-phone-plan/ (last visited July 23, 2018).

[52] *See FCC Device Manufacturers List of All Handsets Offered by Manufacturers – Reporting Period: July 1, 2015-June 30, 2016*, FCC, https://apps.fcc.gov/edocs_public/attachmatch/DOC-341019A1.pdf. As just one example, all devices sold by Kyocera in the U.S. are HAC-compliant. Accessibility Solutions, Kyocera, https://www.kyoceramobile.com/accessibility/ (last visited July 23, 2018).

[53] *See, e.g.*, Siri, Apple, https://www.apple.com/ios/siri/ (last visited July 23, 2018); Bixby, Samsung, https://www.samsung.com/us/explore/bixby/ (last visited July 23, 2018); Cortana, Microsoft,

Veterans. Wireless providers are also increasingly ensuring our nation's veterans and their families have access to reliable, affordable wireless connectivity. T-Mobile, U.S. Cellular, GCI, AT&T, Sprint, and other providers offer specialized service plans and percentage discounts to the veteran community.[54] In addition, Armed Forces Mobile, an MVNO that focuses on providing wireless services to veterans and first responders, recently announced a prepaid unlimited plan for $45 per month.[55] Verizon also offers military families unlimited plans for as low as $30/line with four lines per month.[56]

International Plans. Providers are also increasingly addressing consumers' need to communicate internationally. Nationwide providers each have international options to suit individuals' travel needs.[57] Bluegrass Cellular, Inland Cellular, Cellcom, and other rural and

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https://www.microsoft.com/en-us/cortana (last visited July 23, 2018); Amazon Alexa, Amazon, https://developer.amazon.com/alexa (last visited July 23, 2018); Google Assistant Overview, Google, https://assistant.google.com/#?modal_active=none (last visited July 23, 2018).

[54] *See, e.g.*, T-Mobile ONE Military, T-Mobile, https://www.t-mobile.com/offers/military-phone-plans (last visited July 18, 2018); Military Discount, U.S. Cellular, https://www.uscellular.com/support/faq/military-discount.html (last visited July 18, 2018); Military Offers, GCI, https://www.gci.com/offers/military-offers (last visited July 23, 2018); Sprint salutes Veterans and our Military!, Sprint, https://businesssolutions.sprint.com/dod-military.html (last visited July 23, 2018); The AT&T Signature Program, AT&T, https://www.att.com/offers/discount-program/military-discount/index.html (last visited July 23, 2018).

[55] Press Release, Armed Forces Wireless/Mobile, Inc., Armed Forces Mobile Launches New Prepaid Cellular Service, Supporting Veterans and First Responders in the Process (June 19, 2018), https://www.prnewswire.com/news-releases/armed-forces-mobile-launches-new-prepaid-cellular-service-supporting-veterans-and-first-responders-in-the-process-300668381.html.

[56] Now Military Families Save Even More, Verizon, https://www.verizonwireless.com/military/ (last visited July 18, 2018).

[57] *See, e.g.*, AT&T, International Day Pass, https://www.att.com/offers/international-plans/europe-caribbean-country-more.html (last visited July 23, 2018); Sprint, International, https://support.sprint.com/support/international (last visited July 23, 2018); Verizon, International services while traveling outside the U.S., https://www.verizonwireless.com/solutions-and-services/international-travel/ (last visited July 23, 2018); Stefan Etienne, *T-Mobile Now Offers $5 Day Passes to Bump International Plan to 512MB of LTE*, THE VERGE (July 17, 2018), https://www.theverge.com/2018/7/17/17581322/t-mobile-international-data-plan-5-daily-pass-512mb-4g-lte.

regional carriers also support international services.[58] And MVNO Ultra Mobile provides low-cost plans that include unlimited international calling and texting to dozens of countries across the world.[59]

C. Wireless Consumers Are Obtaining Greater Value from Their Service Providers.

Competition among wireless providers has prompted carriers to think creatively to attract and retain customers. Consumers are reaping the benefits in the form of device promotions, unlimited services, new equipment, faster speeds, additional incentives, and free add-ons.

Many different metrics reflect the fact that wireless users are enjoying greater value from the larger volumes and varieties of service they are consuming. Average monthly revenue per active revenue generating unit ("ARPU") fell 6.8 percent from $41.50 to $38.66 from 2016 to 2017,[60] which represents a record low since CTIA started measuring it in 1993.[61] Put simply, consumers are getting more for their money.

The aggressive advertising efforts of service providers, which are constantly working to differentiate themselves from their competitors, are another indication of the competitive nature of the wireless marketplace. In 2017, AT&T spent $3.772 billion, T-Mobile spent $1.8 billion, U.S. Cellular spent $211 million, Verizon spent $2.643 billion, and Sprint spent $1.3 billion

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[58] *See, e.g.*, International Services, Bluegrass Cellular, https://bluegrasscellular.com/business/international-services (last visited July 23, 2018); International Support, Inland Cellular, https://inlandcellular.com/international-support/ (last visited July 23, 2018); International, Cellcom, https://www.cellcom.com/faq_qa.html?categoryid=4#7 (last visited July 23, 2018).

[59] *See, e.g.*, Colin Gibbs, *Ultra Mobile Targets Foreign Students in U.S. with New campusSIMs Partnership*, FIERCEWIRELESS (July 13, 2017), https://www.fiercewireless.com/wireless/ultra-mobile-targets-foreign-students-u-s-acquisition-campussims.

[60] *CTIA Wireless Industry Indices Report* (2018).

[61] *See id.*

promoting their services.[62] Twenty wireless brands spent an estimated $212.8 million on 102 national TV ad spots in May 2018 alone.[63] The features advertised by the different carriers—the quality and scope of their coverage, the quality of their customer service, their added-value offerings—make a difference to consumers, especially as they increasingly depend on their mobile devices for their media consumption.[64]

D. The Wireless Industry Adds Billions of Dollars to Our Economy and Supports Millions of American Jobs.

The wireless industry also continues to be a tremendous job creator. Approximately 4.7 million jobs rely directly or indirectly on the wireless industry: this includes jobs working for wireless operators, in device and accessories manufacturing, for professional services organizations, or on mobile advertising.[65] The wireless industry also contributes billions of dollars to the U.S. economy—more than $475 billion annually,[66] with nearly half of that through adjacent industries such as semiconductor manufacturing.[67] Significantly, each $1 of the wireless industry's direct GDP contribution results in $3.21 of total GDP impact across the

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[62] *200 Leading National Advertisers 2018 FactPack*, ADVERTISING AGE, at 6 (June 25, 2018), http://adage.com/article/datacenter/200-leading-national-advertisers-2018-index/313794/.

[63] Mike Dano, *T-Mobile Outspent Rivals in TV Ads in May*, FIERCEWIRELESS (June 19, 2018), https://www.fiercewireless.com/wireless/t-mobile-outspends-rivals-tv-ads-may.

[64] *See, e.g.*, *Mobile Internet to Reach 28% of Media Use in 2020*, ZENITH MEDIA (May 29, 2018), https://www.zenithmedia.com/mobile-internet-to-reach-28-of-media-use-in-2020/; Kevin Westcott *et al.*, *Digital Media Trends Survey*, DELOITTE INSIGHTS (Mar. 19, 2018), https://www2.deloitte.com/insights/us/en/industry/technology/digital-media-trends-consumption-habits-survey.html.

[65] *How the Wireless Industry Powers the U.S. Economy*, ACCENTURE, at 3 (Apr. 5, 2018) https://api.ctia.org/wp-content/uploads/2018/04/Accenture-Strategy-Wireless-Industry-Powers-US-Economy-2018-POV.pdf.

[66] *Id.*

[67] *Id.* at 7.

American economy.[68] Based on GDP, the U.S. wireless industry is the 24th largest economy globally, ahead of entire countries such as Norway and Ireland.[69]

The wireless industry also fuels the economy through its network investments. Wireless provider capital expenditures totaled $25.6 billion in 2017.[70] Since 2010, when 4G networks were launched, capital investment has exceeded $229.5 billion, excluding the cost of spectrum.[71] Cumulative capital investment of $514.6 billion as of 2017 increased 5.2 percent from year-end 2016.[72] Nationwide, regional, and rural providers are each investing in network upgrades to remain competitive and meet consumer demand.

The deployment of 5G and the expected increase of IoT devices will only increase this economic effect. Wireless providers are expected to invest up to $275 billion to build out 5G networks nationwide,[73] contributing $500 billion in economic growth and creating three million new jobs.[74] Moreover, machine-to-machine connections will likely increase by at least 10 percent, generating an increase in GDP of $2.26 trillion in the U.S. over a 15-year period (2018-2032).[75]

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[68] *Id*.

[69] *Id*.

[70] *CTIA Wireless Industry Indices Report* (2018).

[71] *Id*.

[72] *Id*.

[73] *Id*.

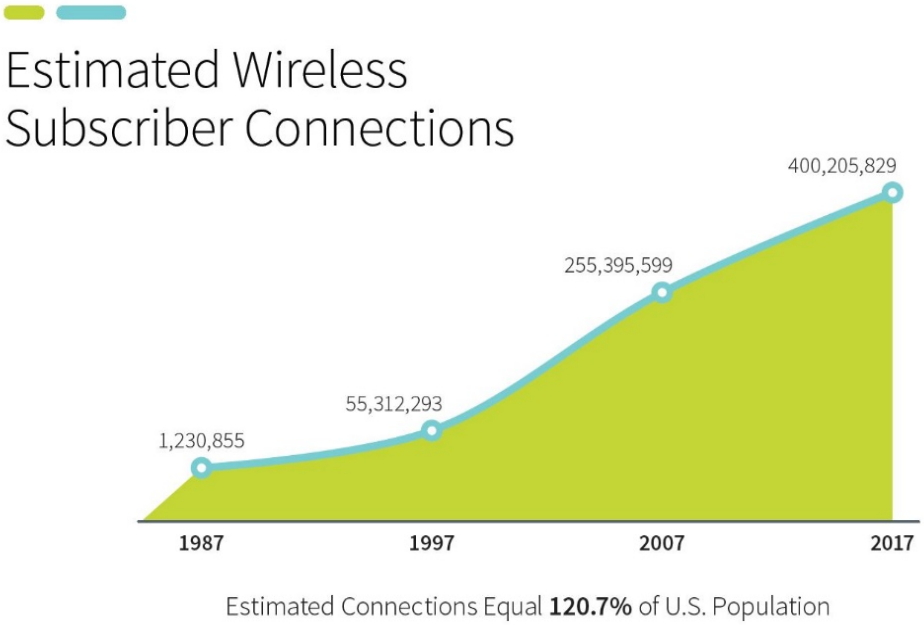
[74] *The Global Race to 5G*, CTIA, at 2 (Apr. 2018), https://api.ctia.org/wp-content/uploads/2018/04/Race-to-5G-Report.pdf ("*The Global Race to 5G*").

[75] *See* Jose Maria Rodriguez and Luigi Stammati, *The Economic Impact of IoT*, FRONTIER ECONOMICS, at 4 (Mar. 2018), https://www.frontier-economics.com/documents/2018/03/internet-things_march-2018.pdf.

III. THE WIRELESS SECTOR CONTINUES TO GROW, WITH COMPETITION DRIVING THE CONTINUED USAGE AND DEPLOYMENT OF WIRELESS CONNECTIVITY AND IOT.

A. Wireless Devices, Connections, and Traffic are Growing Exponentially.

The U.S. wireless market saw another remarkable year in 2017, with the increasing reliance on mobile data by consumers and businesses reflected prominently in year-end statistics. Total estimated wireless connections climbed from 395.9 million in 2016 to 400.2 million in 2017.[76] This represents approximately 1.2 active wireless devices for every person in the U.S.



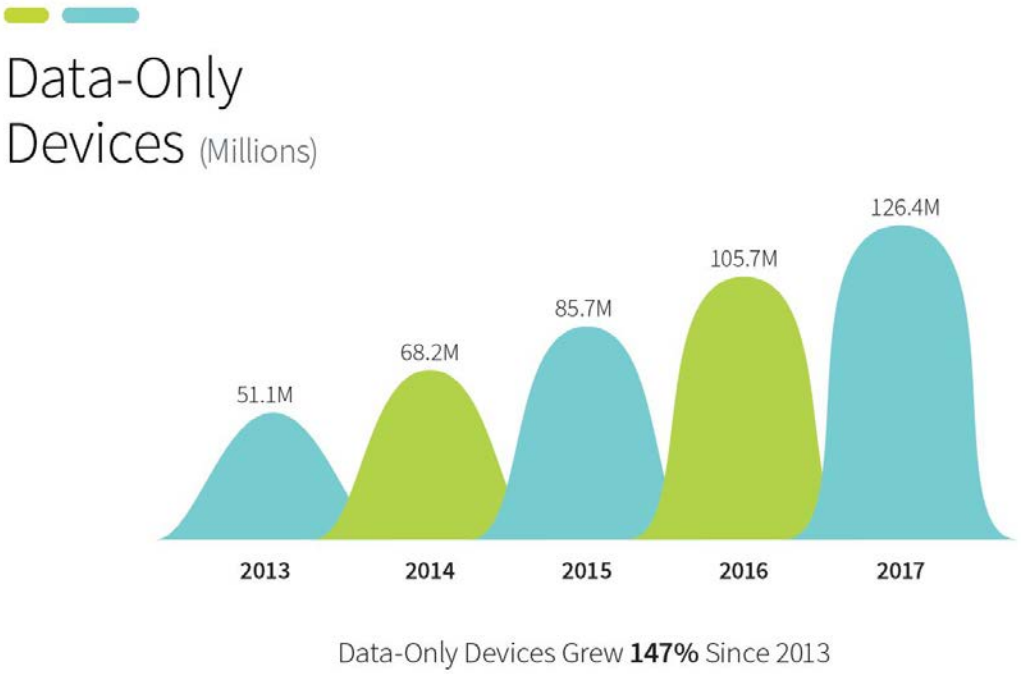
Source: CTIA's Wireless Industry Survey Highlights, Appendix B.

Smartphones alone accounted for 273.2 million of these devices, and when combined with tablets, laptops, and wireless modems, they collectively represented 83 percent of all reported devices.[77] This is a jump of 50 percentage points just since 2010, when these data-

[76] *CTIA Wireless Industry Indices Report* (2018).

[77] *Id.*

centric devices represented only 31 percent of all devices.[78] Perhaps most impressive in 2017 was the dramatic 19.5 percent increase in data-only devices, reaching 126.4 million, indicating the rapid growth of the Internet-of-*Mobile*-Things.[79] The number of these devices has increased nearly 2.5 times from 2013, when CTIA first began tracking them, and their rise seems to be accelerating even more in early 2018: 90 percent of new net wireless connection adds in the first quarter of 2018 came from data-only devices such as connected cars and IoT devices.[80]



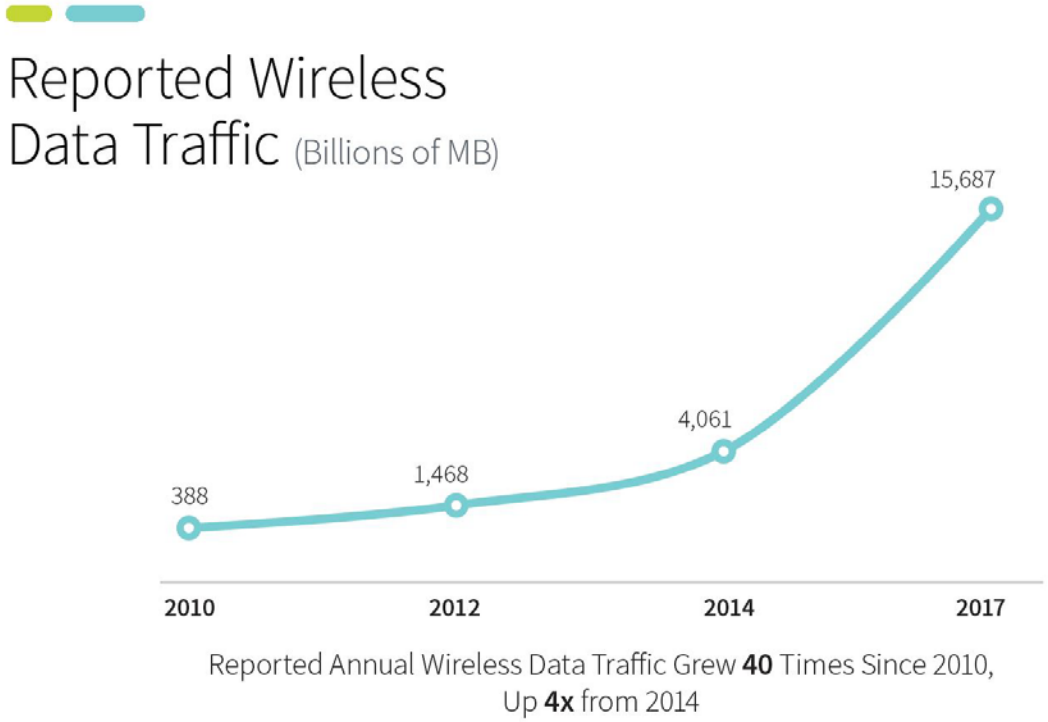
Source: CTIA's Wireless Industry Survey Highlights, Appendix B.

[78] *Id.*

[79] *Id.*

[80] Mike Dano, *90% of Industry's Net Adds Now Coming from Connected Cars, IoT: Chetan Sharma*, FIERCEWIRELESS (May 31, 2018), www.fiercewireless.com/iot/90-industry-s-net-adds-now-coming-from-connected-cars-iot-chetan-sharma.

Given the increase in data-centric devices, it is not surprising that total mobile data traffic was up 14 percent over 2016, reaching 15.7 trillion MBs.[81] Data traffic has quadrupled in the past three years and has increased 40-fold in the past seven.[82]



Source: CTIA's Wireless Industry Survey Highlights, Appendix B.

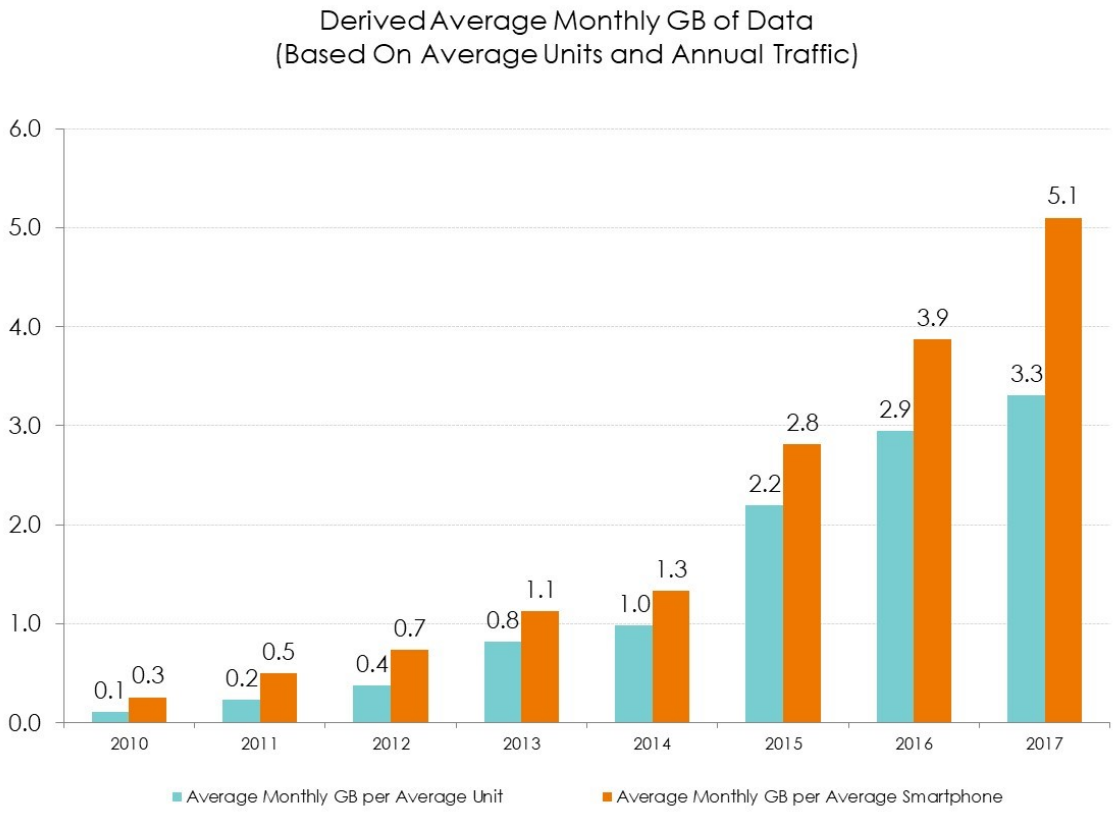
Looking at the data traffic explosion from the perspective of the average smartphone user, monthly traffic per smartphone jumped from 3.9 GB to 5.1 GB, an astounding 30.7 percent increase for a single year.[83] And when measured against 2010 usage levels, this represents a 2,844 percent increase.[84]

[81] *CTIA Wireless Industry Indices Report* (2018).

[82] *Id.*

[83] *Id.*

[84] *Id.*



Source: CTIA's Wireless Industry Indices Report.

Beyond the increases in usage, wireless connectivity is pervasive. Approximately 90.3 percent of households report having at least one wireless phone.[85] Although only 5.8 percent of households reported having a landline connection, but no wireless device,[86] 53.9 percent of households have "cut the cord" and made mobile their sole telephone connection, up from 50.8 percent the prior year.[87]

[85] Stephen J. Blumberg and Julian V. Luke, *Wireless Substitution: Early Release of Estimate from the National Health Interview Survey*, July-December 2017, National Center for Health Statistics, CDC, at 5 (June 7, 2018), https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201806.pdf.

[86] *Id.*

[87] *Id.*

Moreover, as noted above, one in five adults relies exclusively on a mobile device for Internet service, having no fixed broadband connection at home.[88] This is up 54 percent, from 13 percent of adults in 2015.[89]

B. The IoT is Experiencing Explosive Growth Across Industry Sectors, Creating Efficiencies for Consumers and Businesses.

The IoT phenomenon shows no signs of slowing. The number of IoT devices continues to grow approximately 20 percent per year, driven by new use cases.[90] In 2018, the number of IoT devices will surpass the number of mobile phones, and by the end of 2023, analysts now predict that there will be more than 20 billion IoT devices worldwide.[91] These devices include connected cars, machines, meters, sensors, point-of-sale terminals, consumer electronics, and wearables.[92] It is also estimated that by 2025, the average connected person is expected to interact with IoT devices every 18 seconds.[93]

Connectivity to the billions of IoT devices will leverage both licensed and unlicensed communications. The forecast for cellular IoT connections is expected to reach 3.5 billion in

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[88] *See Pew Mobile Fact Sheet*.

[89] *Id*.

[90] *See, e.g.*, *Ericsson Mobility Report*, IoT connections outlook, ERICSSON (Nov. 2017), https://www.ericsson.com/en/mobility-report/reports/november-2017/internet-of-things-outlook ("*Ericsson November 2017 Mobility Report*"); *The Zettabyte Era: Trends and Analysis*, CISCO (June 7, 2017), https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.html.

[91] *See Ericsson November 2017 Mobility Report*.

[92] *Id*.

[93] *See Data Age 2025: The Evolution of Data to Life-Critical*, IDC, at 3 (Apr. 2017), https://www.seagate.com/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf.

2023—increasing at an annual growth rate of 30 percent.[94] This growth is being enabled by cellular IoT technologies such as Narrowband IoT ("NB-IoT") and LTE Category M1 ("LTE Cat-M1"), which will support the massive growth expected.[95] These complementary technologies efficiently support low-power, lower-cost, longer-battery-life devices on the same underlying LTE network.[96] In North America, IoT applications such as connected cars, logistics, and fleet management are already supported by LTE Cat-M1 technology.[97]

In light of this significant growth opportunity, wireless providers, as well as cable operators and other new entrants, are building next-generation networks to support IoT applications. In 2018, there have been numerous IoT network announcements spurred by competition between carriers and new entrants. For example:

- In January 2018, T-Mobile rolled out a $6-a-year rate plan that provides up to 12 MB per connected device,[98] and in July 2018 announced that its NB-IoT network was available nationwide.[99] T-Mobile also announced plans to launch Cat-M1 capabilities across its network in the coming year.[100]

[94] *See Ericsson Mobility Report*, IoT connections outlook, ERICSSON (June 2018), https://www.ericsson.com/en/mobility-report/reports/june-2018/iot-connections-outlook, ("*Ericsson June 2018 Mobility Report*").

[95] *Id*.

[96] *Id*.

[97] *Id*.

[98] *See* Dan Jones, *T-Mobile Rolls Out $6-a-Year NB-IoT Plan*, LIGHT READING (Jan. 9, 2018), https://www.lightreading.com/iot/nb-iot/t-mobile-rolls-out-$6-a-year-nb-iot-plan/d/d-id/739517; Press release, T-Mobile, T-Mobile Launches Nation's First Plan for Narrowband IoT (Jan. 8, 2018), https://www.t-mobile.com/news/narrowband-iot.

[99] Mike Dano, *T-Mobile Launches NB-IoT Nationwide*, FIERCEWIRELESS (July 19, 2018), https://www.fiercewireless.com/iot/t-mobile-launches-nb-iot-nationwide.

[100] *Id*.

- In February 2018, Verizon announced that it had started to deploy NB-IoT services across its network.[101] This was in addition to LTE Cat-M1 capabilities introduced in late 2015.[102]
- In May 2018, DISH announced that it plans to spend between $500 million and $1 billion through 2020 building out the "first phase" of its wireless network, which will initially support NB-IoT capabilities.[103]
- In June 2018, AT&T announced that it will deploy NB-IoT on its network in the U.S. in early 2019.[104] This network will support LTE connections up to 200 Kbits/second using just 180 kilohertz of spectrum.[105] The new NB-IoT network will be in addition to the LTE Cat-M1 capabilities that AT&T already supports on its network.[106]

Smart technologies are also helping consumers manage tasks in the home and make their businesses more efficient. The wearable technology market, which includes devices such as smart watches, fitness trackers, virtual reality eyewear, and wearable cameras, is expected to grow by 16 percent per year to $50 billion in 2022.[107] But consumer wearables are only a small part of the larger IoT ecosystem. According to IDC, worldwide spending on IoT is forecast to reach $772.5 billion in 2018, an increase of 14.6 percent over 2017.[108] The industries expected to spend the most on IoT solutions in 2018 are manufacturing ($189 billion), transportation ($85

[101] Dan Jones, *Verizon Boards the NB-IoT Train*, LIGHT READING (Feb. 2, 2018), https://www.lightreading.com/iot/nb-iot/verizon-boards-the-nb-iot-train/d/d-id/740257.

[102] *See* Internet of Things (IoT) Solutions, Verizon, http://www.verizonenterprise.com/products/internet-of-things/ (last visited July 18, 2018).

[103] Mike Dano, *Dish's Ergen on NB-IoT Network: 'You Shouldn't Expect That We Would Make Big Profits on That on Day One'*, FIERCEWIRELESS (May 8, 2018), https://www.fiercewireless.com/iot/dish-s-ergen-nb-iot-network-you-shouldn-t-expect-we-would-make-big-profits-day-one.

[104] Dan Jones, *AT&T Buckles Down to Deploy NB-IoT in 2019*, LIGHT READING (June 20, 2018), https://www.lightreading.com/iot/nb-iot/atandt-buckles-down-to-deploy-nb-iot-in-2019/d/d-id/744098.

[105] *Id*.

[106] *Id*.

[107] *See Wearable Technology Market Research Report – Forecast 2022*, MARKET RESEARCH FUTURE (July 2018), https://www.marketresearchfuture.com/reports/wearable-technology-market-2336.

[108] Press Release, IDC, IDC Forecasts Worldwide Spending on the Internet of Things to Reach $772 Billion in 2018 (Dec. 7, 2018), https://www.idc.com/getdoc.jsp?containerId=prUS43295217.

billion), and utilities ($73 billion).[109] IoT spending among manufacturers will largely focus on solutions that support manufacturing operations and product asset management.[110] In transportation, two thirds of IoT spending will go toward freight monitoring, followed by fleet management.[111] IoT spending in the utilities industry will be dominated by smart grids for electricity, gas, and water.[112] Use cases common to all industries, such as connected cars and buildings, will be nearly $92 billion in 2018, and represents one of the top areas in the coming years.[113] As discussed in more detail below, the advent of 5G networks will further accelerate the growth of the IoT marketplace.

IV. WIRELESS PROVIDERS ARE IMPROVING THEIR NETWORKS AND EXPANDING SERVICE TO NEW LOCATIONS, AND NEW ENTRANTS ARE JOINING THE RACE TO THE TOP.

A. Wireless Providers are Competing to Deploy New and Advanced Networks and Technologies.

Wireless providers, including nationwide, regional, and rural mobile wireless carriers and new entrants like traditional cable operators, remain focused on improving the quality and expanding the reach and capacity of their networks. This competitive market represents a success story for U.S. consumers, who benefit from the greater availability and functionality of wireless services. Progress has been clear: a record 323,448 cell sites were in operation in 2017, representing a 52 percent growth over the last decade,[114] and almost all of the country's population now has access to advanced wireless services. Indeed, 4G LTE service is now

[109] *Id.*

[110] *Id.*

[111] *Id.*

[112] *Id.*

[113] *Id.*

[114] *CTIA Wireless Industry Indices Report* (2018).

available to at least 99.7 percent of Americans and covers more than 73 percent of the total U.S. land area.[115] As the next big step, wireless providers are trialing 5G technologies and equipment,[116] and are announcing commercial rollouts as well. This transition to 5G requires the implementation of many new network technologies, although many of these technologies also will benefit existing 4G LTE networks even before 5G appears in a particular market.

Small Cells. The deployment of small cells, which helps satisfy consumers' data demands and provides an important network densification precursor for 5G, is expected to see a skyrocketing increase of 550 percent in 2018.[117] Already, well over half (62 percent) of all of Verizon's wireless deployments in 2017 were small cell.[118] T-Mobile's small cell program will see 25,000 deployments by early 2019, on top of the approximately 18,000 small cells and distributed antenna system nodes that were already deployed by year-end 2017.[119] Sprint announced that it will deploy 40,000 outdoor small cell solutions.[120] In addition to rollouts by the nationwide carriers, lower deployment costs typically associated with small cells as compared to traditional macro deployments make these technologies similarly suitable for

[115] *Twentieth Report* at App. III, Table III.D.iv. By comparison, in 2009, only 40 percent of the land area was covered by mobile broadband service. *Implementation of Section 6002(b) of the Omnibus Reconciliation Act of 1993*, Thirteenth Report, 24 FCC Rcd 6185 ¶ 146, Table 10 (2009).

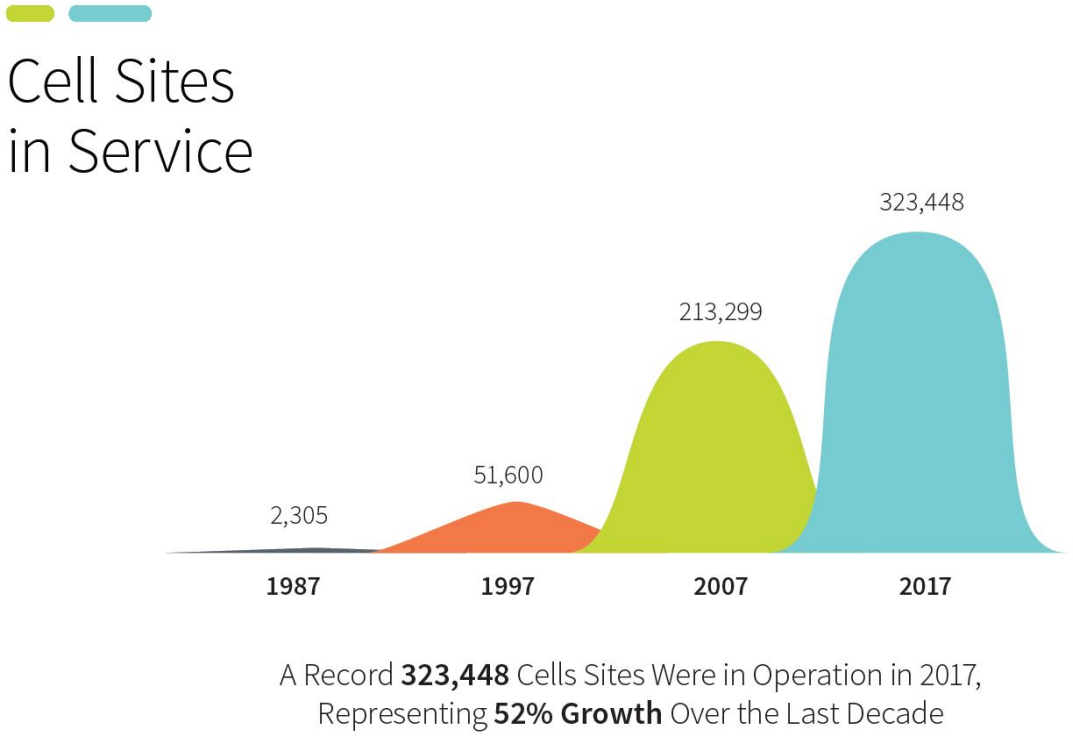
[116] *See, e.g.*, *The Global Race to 5G* at 8.

[117] *Impact of Federal Regulatory Reviews on Small Cell Deployment*, ACCENTURE STRATEGY, at 3 (Mar. 12, 2018), https://api.ctia.org/wp-content/uploads/2018/04/Accenture-Strategy-Impact-of-Federal-Regulatory-Reviews-On-Small-Cell-Deployment-Report_2018.pdf ("*Accenture Report*").

[118] Mike Dano, *Verizon: Around 62% of All Wireless Deployments in 2017 Were Small Cell*, FIERCEWIRELESS (Mar. 6, 2018), https://www.fiercewireless.com/wireless/verizon-around-62-all-wireless-deployments-2017-were-small-cells.

[119] *Id.*

[120] Mike Dano, *Sprint Confirms Magic Box Deployment Trial with MasTec*, FIERCEWIRELESS (Apr. 11, 2018), https://www.fiercewireless.com/tech/sprint-confirms-magic-box-deployment-trial-mastec.



Source: CTIA's Wireless Industry Survey Highlights, Appendix B.

smaller and rural carriers. Nex-Tech Wireless for instance, which provides service in Kansas and Colorado, began deploying small cells in 2015.[121] Industry wide, total small cell deployment is expected to reach 200,000 by the end of next year.[122] As discussed further in Section VII.A., the Commission's recent action to exempt small cells from lengthy and expensive federal regulatory review requirements is an important step towards ensuring that this pace is met. Further progress on these issues can ensure these technologies can be rapidly and efficiently deployed across the country.

[121] *Nex-Tech Wireless Uses Airvana OneCell to Deliver LTE in Packed Coliseum*, COMMSCOPE (June 9, 2015), https://www.commscope.com/NewsCenter/PressReleases/Nex-Tech-Wireless-Uses-Airvana-OneCell-to-Deliver-LTE-in-Packed-Coliseum/. The carrier cited small cells as one example of how "as a small operator, we compete by using technology to provide superior service at competitive prices." *Id.*

[122] *Accenture Report* at 3.

VoLTE. Voice over LTE ("VoLTE") improves voice quality and moves the voice traffic to a data channel. By eliminating the need for a separate voice network, it will facilitate the evolution to all-IP wireless networks. VoLTE deployment accelerated significantly in the past year. Verizon and T-Mobile now have VoLTE on 100 percent of their LTE networks,[123] and U.S. Cellular began VoLTE deployment in Iowa in 2017, with planned rollouts in additional markets in 2018.[124] Sprint will launch the technology this fall and is already providing customers with VoLTE-capable devices.[125] And AT&T's VoLTE network covers more than 320 million POPs, with the majority of its post-paid customers on VoLTE-capable smartphones.[126]

License-Assisted Access. As evidence of how quickly carriers can transition to new technologies in a competitive environment, 2017 saw nationwide carriers announce deployments of License-Assisted Access ("LAA") which, like its predecessor LTE-U, pairs licensed spectrum with unlicensed spectrum.[127] LAA is considered an enabler for much higher download speeds using a supplemental channel with as little as 20 megahertz of licensed spectrum.[128] Testing has shown that devices with LAA support a consistently higher data rate, with three-times faster

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[123] Monica Alleven, *Sprint Expects to Deploy VoLTE Starting This Fall*, FIERCEWIRELESS (Feb. 14, 2018), https://www.fiercewireless.com/wireless/sprint-expects-to-deploy-volte-fall ("*Sprint Expects to Deploy VoLTE Starting This Fall*").

[124] Press Release, U.S. Cellular, U.S. Cellular Reports Second Quarter 2017 Results (Aug. 4, 2017), http://investors.uscellular.com/news/news-release-details/2017/US-Cellular-reports-second-quarter-2017-results/default.aspx.

[125] *Sprint Expects to Deploy VoLTE Starting This Fall*.

[126] Monica Alleven, *Editor's Corner – Hear Ye, Hear Ye: Does Voice Have a Role in 5G?*, FIERCEWIRELESS (Feb. 22, 2018), https://www.fiercewireless.com/wireless/editor-s-corner-hear-ye-hear-ye-does-voice-have-a-role-5g.

[127] LTE-U, which did not go through the normal 3GPP standards-setting process, reached the market first.

[128] Keith Mallinson, *Analyst Angle: How to Provide Gigabit LTE Cheaply When You Don't Have the Spectrum?*, RCRWIRELESS (Jan. 15, 2018), https://www.rcrwireless.com/20180114/analyst-angle/analyst-angle-how-to-provide-gigabit-lte-cheaply-when-you-dont-have-the-spectrum-Tag9.

download speeds.[129] All major carriers have tested LAA and reportedly achieved speeds ranging from 120 Mbps (using only five megahertz of licensed spectrum) to more than 1 Gbps (relying on LAA with a combination of other technologies).[130] Verizon and T-Mobile plan widespread deployment of LAA in 2018, and AT&T has indicated that 24 markets will be covered by year-end.[131]

Massive MIMO. Massive multiple-input and multiple-output ("MIMO"), which groups multiple antennas at the transmitter and receiver to provide better throughput and spectral efficiency, is another 5G precursor technology that is currently being introduced to expand the capacity of existing LTE networks.[132] The larger number of transmitters enables beamforming, which allows the signal to be aimed towards the mobile unit using accurate and narrow beams. This reduces interference and improves signal quality, providing expanded cell coverage and capacity.[133] Sprint, which has already announced plans to launch commercial massive MIMO operations later this year, conducted field trials with Samsung last year and was able to increase channel capacity by 300 percent and boost cell edge performance by 200 percent, achieving peak speeds of over 300 Mbps using a single 20-megahertz channel.[134] Verizon has also tested

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[129] Kelly Hill, *Four Pillars of 5G*, RCRWIRELESS (Dec. 4, 2017), https://www.rcrwireless.com/20171130/test-and-measurement/four-pillars-of-5g-tag6-tag99.

[130] *Sprint enters LAA race*, MOBILE WORLD LIVE (Dec. 11, 2017), https://www.mobileworldlive.com/featured-content/top-three/sprint-enters-laa-race/.

[131] *Id.*; *AT&T Builds on 5G Foundation in More than 100 New Markets*, AT&T Newsroom (Apr. 20, 2018), http://about.att.com/story/att_builds_on_5g_foundation_in_more_than_100_new_markets.html.

[132] Sean Kinney, *What is massive MIMO?*, RCRWIRELESS (June 28, 2017), www.rcrwireless.com/20170628/5g/what-is-massive-mimo-tag17-tag99.

[133] Daryl Schoolar, *Massive MIMO Comes of Age*, OVUM, at 3, https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/massive-mimo-comes-of-age/global-networks-insight-massive-mimo-comes-of-age-0.pdf.

[134] Susan Rambo, *Sprint's 5G strategy: Massive MIMO Key to 2.5 GHz Rollout*, RCRWIRELESS (May 16, 2018), https://www.rcrwireless.com/20180516/5g/sprints-5g-strategy-massive-mimo-key-to-2-5-ghz-

massive MIMO as a critical component of its 4G LTE advancements.[135] Commercial smartphones that support massive MIMO are being introduced this year.[136] Massive MIMO will be a key technology, enabling very fast throughput speeds in 5G technology.

Narrowband-IoT. As discussed above, NB-IoT networks are being introduced by wireless operators to provide a lower cost, more efficient service option for the growing proliferation of sensors and other very basic IoT devices that need low-power consumption connectivity and can operate on low speed connections. NB-IoT can even rely on underutilized guard band spectrum, which frees up capacity on the primary networks.[137]

Network function virtualization. Perhaps one of the biggest technological game changers, network function virtualization ("NFV") promises to enable the provision of dramatically more flexible, innovative, and cost-effective services (including support for 5G requirements for super high-speed and low-latency connections) when combined with software defined networks ("SDN"). This advancement will be achieved by decoupling software from hardware. These technologies enable more efficient, timely, and cost-effective deployment of software onto commercial off-the-shelf ("COTS") hardware. These technologies have already been deployed in some Information Technology ("IT") industries and are now being

rollout-tag41; Sean Kinney, *What is massive MIMO?*, RCRWIRELESS (June 28, 2017), www.rcrwireless.com/20170628/5g/what-is-massive-mimo-tag17-tag99.

[135] Sean Kinney, *Verizon expanding from 4x4 MIMO with new project in Irvine, California*, RCRWIRELESS (Oct. 27, 2017), https://www.rcrwireless.com/20171027/5g/verizon-ericsson-massive-mimo-tag17.

[136] Sean Kinney, *Three Operator Trends to Watch in 2018*, RCRWIRELESS (Feb. 5, 2018), https://www.rcrwireless.com/20180205/carriers/three-operator-trends-to-watch-in-2018-tag17-tag99.

[137] *See* Mike Dano, *Verizon commits to nationwide NB-IoT network buildout in 2018*, FIERCEWIRELESS (Feb. 1, 2018), https://www.fiercewireless.com/iot/verizon-commits-to-nationwide-nb-iot-network-buildout-2018.

standardized for use in wireless telecommunications networks.[138] Services and functions originally installed on proprietary hardware will be able to be performed by open-source software on "virtual machines."[139] AT&T expects to roll out more than 60,000 "white box" routers at cell sites across the U.S. over the next several years.[140] Moreover, AT&T reported that it has already virtualized 55 percent of its core network functions, with the goal of reaching 65 percent in 2018 and 75 percent by 2020.[141] Sprint, too, is building a new virtual core, announcing in Q3 2017 that its Short Message Service ("SMS") traffic would be transitioned to its NFV platform by year-end, and that its Multimedia Messaging Service ("MMS") would be transitioned in 2018.[142] Sprint indicated that network virtualization would enable "an expanding range of innovative services" to customers for years to come.[143] Verizon also offers NFV and SDN solutions, which it says can, among other benefits, "deliver seamless HD media for better user experiences with video training, conferencing and web content."[144]

B. Wireless Providers Are Competing to Offer Services in Rural Areas, Helping To Close the Digital Divide.

Wireless competition is helping to close the digital divide, as wireless providers, both regional and nationwide, are investing in providing coverage to underserved and unserved

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[138] Nathan Cranford, *What Is Network Functions Virtualization?*, RCRWIRELESS (June 20, 2017), https://www.rcrwireless.com/20170620/wireless/what-is-network-function-virtualization-tag27-tag99.

[139] *Id.*

[140] *AT&T is Deploying White Box Hardware in Cell Towers to Power Mobile 5G Era*, AT&T Newsroom (Mar. 25, 2018), http://about.att.com/story/att_deploying_white_box_hardware_in_cell_towers.html.

[141] *Id.*

[142] Günther Ottendorfer, *The Sprint NFV Journey: Accelerating Mobile Network Innovation with NFV OpenStack Cloud*, Sprint Newsroom (Sept. 5, 2017), http://newsroom.sprint.com/the-sprint-nfv-journey.htm.

[143] *Id.*

[144] Drive business agility with a fast, intelligent network, Verizon, http://www.verizonenterprise.com/products/networking/sdn-nfv/ (last visited July 25, 2018).

communities across the country. Providers continue to improve the scope and speed of their coverage in rural and high-cost areas to offer the most comprehensive nationwide coverage and support services addressing the needs of rural America.

Expanding Rural Coverage. Metrics from the Commission's most recent mobile wireless competition reports reflect this improvement in rural coverage. Last year, the Commission estimated that approximately 84.2 percent of the rural population was covered by at least three LTE service providers.[145] This represents a 3.6 percentage point increase from the prior year,[146] and a 19.4 percentage point increase from the statistics reported in 2015.[147]

Significantly, this positive trend is expected to continue, and the deployment of services using 600 MHz band spectrum will be key in this effort. T-Mobile, for example, has already activated this spectrum band in more than 900 cities and towns in 32 states, bringing T-Mobile LTE coverage into 120 places for the first time.[148] This effort reflects T-Mobile's focus on deploying 600 MHz spectrum in rural areas previously unserved by T-Mobile's 700 MHz

[145] *Twentieth Report* at Chart III.D.11 (based on FCC Form 477 data, Centroid Method, December 2016).

[146] *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Nineteenth Report, 31 FCC Rcd 10534, Chart III.A.5 (2016) (based on FCC Form 477 data, Centroid Method, December 2015).

[147] *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Eighteenth Report, 30 FCC Rcd 14515, Chart III.A.5 (2015) (based on July 2015 Mosaik and 2010 Census data).

[148] Press Release, T-Mobile, T-Mobile 600 MHz Extended Range LTE Now Live in 900+ Cities & Towns, Coming to Puerto Rico (June 6, 2018), https://www.t-mobile.com/news/extended-range-lte-puerto-rico; *see also* T-Mobile, *T-Mobile 600 MHz Cities and Towns* (June 2018), https://www.t-mobile.com/content/dam/t-mobile/corporate/newsroom/articles/2018/06/600-mhz-pr/600MHzCitiesTowns6.6.2018.pdf.

spectrum.[149] Regional carriers Bluegrass Cellular and East Kentucky Network similarly have invested in additional spectrum resources in the band.[150]

Regional and nationwide providers are also investing in testing and deploying 5G technologies in rural areas.[151] 5G networks in rural areas will support local industries, such as agriculture, as well as telehealth and telemedicine applications that can bring state-of-the-art medical care to even the most remote rural areas.[152] As discussed in more detail in Section VII, access to sufficient spectrum and streamlined infrastructure rules are critical for innovations of this nature to be deployed across the country to the benefit of a diverse range of consumers.

Expanded rural coverage yields not just the wide range of benefits that accompany increased access to the Internet, but also provides targeted services such as smart agriculture and telemedicine. As Commissioner Brendan Carr observed, with the help of "broadband-enabled, smart ag applications, . . . farmers are seeing at least a 30% increase in productivity and crop yields, not to mention a significant reduction in the use of fertilizer, pesticides, and water."[153]

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[149] *See, e.g.*, Press Release, T-Mobile, T-Mobile Lights Up World's First 600 MHz LTE Network at Breakneck Pace (Aug. 15, 2017), https://www.t-mobile.com/news/cheyenne-600-mhz ("Starting in rural America and other markets where the spectrum is clear of broadcasting today, T-Mobile plans to deploy the new super-spectrum at record-shattering pace—compressing what would normally be a two-year process from auction to consumer availability into a short six months."); Letter from Steve B. Sharkey, Vice President, Government Affairs, Technology and Engineering Policy, T-Mobile, to Marlene H. Dortch, Secretary, FCC, at 1 (Aug. 4, 2017); Diana Goovaerts, *T-Mobile highlights 600MHz deployment progress*, MOBILE WORLD LIVE (Jan. 4, 2018), https://www.mobileworldlive.com/featured-content/top-three/t-mobile-highlights-600mhz-deployment-progress/.

[150] *See Incentive Auction Closing and Channel Reassignment Public Notice, et al.*, Public Notice, 32 FCC Rcd 2786, at Appendix B (2017).

[151] *See* Diana Goovaerts, *Rural US Carriers Push 4G Ahead of 5G Spectrum Battle*, MOBILE WORLD LIVE (Mar. 23, 2018), https://www.mobileworldlive.com/featured-content/top-three/4g-top-of-mind-as-rural-us-operators-eye-5g-future/.

[152] *See also* Section V.A.

[153] Brendan Carr, *From Farm to Cloud: How Broadband Makes Smart Ag Brilliant*, Medium, https://medium.com/@BrendanCarrFCC/from-farm-to-cloud-how-broadband-makes-smart-ag-brilliant-ae41a08cc04f (May 25, 2018); *cf.* Susan Rambo, *Wireless Smart Farming to Keep Frost Away from*

5G networks will allow farmers to monitor crops, climates, livestock, equipment, and commodities markets.[154]

Notwithstanding this progress, federal support, including through a robust Mobility Fund, remains crucial. As discussed below, such support will enable wireless providers to increasingly serve rural and high-cost areas where consumers lack access to critical mobile wireless broadband services.

Federal support. Although mobile wireless providers continue to invest and deploy service in rural areas, federal support remains crucial to expanding competitive access to high-quality wireless services in rural and high-cost areas and closing the digital divide. CTIA shares the Commission's focus on delivering mobile wireless services to unserved areas of the United States. The Mobility Fund Phase II Auction—and $453 million in annual support—is an important step toward that goal. A robust and efficient Mobility Fund will enable wireless providers to preserve and extend 4G LTE coverage to rural and hard-to-serve areas where consumers lack access to critical mobile wireless broadband services.

Other efforts, such as passage of the bipartisan AIRWAVES Act,[155] would also help bridge the digital divide and connect more rural communities across the country. [156] Among

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Citrus, RCRWIRELESS, https://www.rcrwireless.com/20180717/internet-of-things/wireless-smart-farming-to-keep-frost-away-from-citrus-tag41 (July 17, 2018).

[154] *See, e.g.*, FCC Chairman Pai Remarks to Kansas Broadband Conference (Sept. 21, 2017), https://www.fcc.gov/document/chairman-pai-remarks-kansas-broadband-conference.

[155] Advancing Innovation and Reinvigorating Widespread Access to Viable Electromagnetic Spectrum Act (AIRWAVES Act), H.R. 4953, 115th Cong. (2018); Advancing Innovation and Reinvigorating Widespread Access to Viable Electromagnetic Spectrum Act (AIRWAVES Act), S.1682, 115th Cong. (2017) ("AIRWAVES Act").

[156] *See The AIRWAVES Act Provides Critical 5G Spectrum & Encourages Rural Wireless Deployment*, CTIA BLOG (June 11, 2018), https://www.ctia.org/news/the-airwaves-act-provides-critical-5g-spectrum-encourages-rural-wireless-deployment; The AIRWAVES Act, CTIA, https://www.ctia.org/news/the-airwaves-act-policy-brief (last visited July 22, 2018) ("*The AIRWAVES Act*").

other measures intended to enhance existing wireless service and unleash next-generation broadband in communities across America, the AIRWAVES Act sets a timeline for auctioning a series of critical low-, mid-, and high-bands, including those already identified by the federal government.[157] The AIRWAVES Act then sets aside 10 percent of proceeds from these auctions to deploy wireless in underserved, often rural areas.[158] It also requires the Commission to study the impact of unlicensed spectrum on rural healthcare, education, agriculture, and broadband access.[159] In these ways, the AIRWAVES Act would help connect even more rural communities across our country by providing support for areas that are economically challenging to serve.

C. New Entrants, Such as Cable Companies and Satellite Providers, Are Actively Engaged in Efforts to Deploy New Broadband Services.

Multiple new entrants, including cable operators and satellite companies, are poised to compete aggressively in the wireless market.

Cable Companies. Cable operators are entering the mobile wireless market by leveraging their extensive Wi-Fi networks and the ubiquity of Wi-Fi-enabled devices along with MVNO relationships to offer services using complementary wireless licensed and unlicensed networks. Indeed, cable operators have already made a successful entry into the wireless market. Morgan Stanley Research predicted that cable operators will add approximately 2.2 million mobile customers in 2020, which is nearly 50 percent of predicted total net customer additions for the wireless industry.[160]

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[157] *See The AIRWAVES Act*.

[158] *See id*.

[159] *See id*.

[160] Mike Dano, *Analyst: Cable MVNOs to Steal 50% of All Wireless Customer Additions by 2020*, FIERCEWIRELESS (June 27, 2018), https://www.fiercewireless.com/wireless/analyst-cable-mvnos-to-steal-50-all-wireless-customer-additions-by-2020.

In 2017, Comcast launched its Xfinity Mobile wireless service using its growing network of 19 million Wi-Fi hotspots supplemented by an MVNO arrangement with Verizon for access to the nationwide carrier's 4G network.[161] Thereafter, Comcast has added more phone customers than Verizon and AT&T in 2017[162] and more postpaid wireless subscribers than Sprint did in the final quarter of 2017.[163] In the following quarter, Xfinity Mobile added another 196,000 subscribers—an increase in their subscriber base of more than 50 percent.[164] In June 2018, Charter Communications launched Spectrum Mobile, which is enabled by Verizon's mobile network.[165] Altice USA and Sprint recently announced an agreement for Altice to sell voice and data services on the Sprint network, while Sprint will use Altice's cable infrastructure for its 5G network, signaling another major cable provider's move into the wireless marketplace.[166]

Cable operators are also able to leverage their wireline and wireless infrastructure to enable broader Wi-Fi deployments and protect against heavy reliance upon licensed spectrum for broader coverage. These expansive fiber networks offer platforms for further cell site densification, increased capacity, broader coverage, and greater throughput.

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[161] *See* Press Release, Comcast, How Xfinity Mobile's Flexible Service Plan Gives Consumers the Ultimate Value and Peace of Mind (May 17, 2018), https://corporate.comcast.com/stories/how-xfinity-mobiles-flexible-service-plan-gives-consumers-the-ultimate-value-and-peace-of-mind.

[162] *See* Mike Dano, *Sprint Matches Comcast's Xfinity Mobile in Q4 Postpaid Customer Gains*, FIERCEWIRELESS (Feb. 2, 2018), https://www.fiercewireless.com/wireless/sprint-matches-comcast-s-xfinity-mobile-q4-postpaid-customer-gains (quoting a Morgan Stanley Research analyst).

[163] *Id.*

[164] Gerry Smith, *Comcast Is Now an Internet Company, Not a Cable-TV Provider*, BLOOMBERG (Apr. 25, 2018), https://www.bloomberg.com/news/articles/2018-04-25/comcast-s-sky-tv-bid-belies-a-shift-away-from-video-in-the-u-s.

[165] Mike Farrell, *Charter Launches Spectrum Mobile*, MULTICHANNEL NEWS (July 3, 2018), https://www.multichannel.com/news/charter-launches-spectrum-mobile.

[166] Press Release, Sprint Corp., Sprint, Altice USA Announce Strategic MVNO Agreement (Nov. 5, 2017), http://newsroom.sprint.com/sprint-altice-usa-announce-strategic-mvno-agreement.htm.

Both Charter and Comcast are also favorably positioned for the deployment of fixed and mobile 5G operations, allowing them to directly compete with mobile network operators on a nationwide basis in the near future. Cable networks use multi-node, remotely powered network topology that is well suited for 5G deployments.[167] With the rapid expansion of small cell deployments driving the buildout of 5G networks, the distance a wireless connection will need to travel will become shorter and shorter. The dense hybrid fiber-coaxial networks of Comcast, Charter, and others create last-mile footprints that will become increasingly valuable strategic assets as reliance on small cells increases.[168]

Charter and Comcast recently finalized a partnership that will allow the cable operators to share each other's operating platforms, accelerating mobile broadband deployment.[169] Leveraging their large infrastructure footprint, Comcast and Charter have also demonstrated a commitment to further building out their wireless networks with licensed spectrum. Comcast recently acquired 10 megahertz of spectrum covering 145 million POPs for $1.7 billion in the 600 MHz incentive auction.[170] Moreover, both Charter and Comcast have undertaken field

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[167] *See, e.g.*, Don Clarke, *5G — The Beginning of an Exhilarating Journey*, CABLELABS (Dec. 2, 2015), https://www.cablelabs.com/5g-the-beginning-of-an-exhilarating-journey/.

[168] *See* Mari Silbey, *Cisco: Cable Nets Can Backhaul Small Cells*, LIGHT READING (Oct. 18, 2018), http://www.lightreading.com/cable/docsis/cisco-cable-nets-can-backhaul-small-cells/d/d-id/737372.

[169] Press Release, Charter Communications, Comcast and Charter Announce Mobile Operating Platform Partnership (Apr. 20, 2018), https://newsroom.charter.com/press-releases/comcast-charter-announce-mobile-operating-platform-partnership/.

[170] *See* Press Release, Comcast, Comcast Corporation Statement on FCC Broadcast Incentive Auction Results (Apr. 13, 2017), http://corporate.comcast.com/news-information/news-feed/comcast-corporationstatement-on-fcc-broadcast-incentive-auction-results; *see also* Colin Gibbs, *Mapping T-Mobile, Dish, Comcast and AT&T: Who Got How Much 600 MHz Spectrum and Where?*, FIERCEWIRELESS (Apr. 18, 2017), https://www.fiercewireless.com/wireless/mapping-t-mobile-dish-comcast-and-at-t-who-got-how-much-600-mhz-spectrum-and-where.

testing of wireless service in the 3.5 GHz Citizens Broadband Radio Service ("CBRS") band.[171] Charter is also conducting testing of 5G service in the 28 GHz band,[172] for which spectrum auction bidding is slated to begin in mid-November 2018.[173] As additional mid-band spectrum and millimeter wave spectrum bands come to auction, cable operators will have multiple opportunities to expand their wireless portfolios and deploy networks with broader coverage and better quality.

DISH Network Corporation. In recent years, DISH—a direct broadcast satellite television provider—has been active in acquiring significant amounts of spectrum suitable for offering terrestrial mobile services. In aggregate, DISH has available nearly 95 megahertz of spectrum nationwide under 3 GHz, which is comparable to the spectrum holdings of existing nationwide providers.[174] DISH could use its spectrum holdings either to deploy a new terrestrial mobile broadband network or to supplement networks of existing providers. In May 2018, DISH affirmed its plans to build a wireless network by March 2020.[175]

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[171] *See* Comcast CBRS, LLC, ELS File No. 0110-EX-CN-2018 (granted Feb. 26, 2018); *see also* CCO Fiberlink, LLC, ELS File No. 0296-EX-ST-2018 (granted Mar. 23, 2018).

[172] Monica Alleven, *Charter Seeks STA for More 5G Tests, This Time with Ericsson Gear at 28 GHz in Los Angeles*, FIERCEWIRELESS (Mar. 6, 2018), https://www.fiercewireless.com/wireless/charter-seeks-sta-for-more-5g-tests-time-ericsson-gear-at-28-ghz-los-angeles.

[173] *See Auctions of Upper Microwave Flexible Use Licenses for Next-Generation Wireless Services; Comment Sought on Competitive Bidding Procedures for Auctions 101 (28 GHz) and 102 (24 GHz); Bidding in Auction 101 Scheduled to Begin November 14, 2018*, Public Notice, AU Docket No. 18-85, FCC 18-43 (rel. Apr. 17, 2018).

[174] Kendra Chamberlain, *Dish's 'Undervalued' Spectrum Assets Worth $30.2B*, FIERCEWIRELESS (Mar. 27, 2018), https://www.fiercewireless.com/wireless/dish-s-undervalued-spectrum-assets-worth-30-2b-analyst.

[175] *See, e.g.*, American H Block Wireless L.L.C. Interim Construction Notification for H Block Licenses, ULS File No. 0008210492 (filed May 14, 2018); Letter from Jeff Blum, Senior Vice President & Deputy Gen. Counsel, DISH Network Corp., to Marlene H. Dortch, Secretary, FCC (May 24, 2018), https://ecfsapi.fcc.gov/file/10525286088947/2018-05-24%20DISH%20Ex%20Parte%20GN%20Docket%20No.%2017-183.pdf.

Satellite Service Providers. Historically, satellite operators have served niche markets or remote areas where terrestrial networks were limited or unavailable. Recently, however, satellite providers have touted advances in satellite and antenna technology that will introduce the potential for more sophisticated devices and faster broadband services at lower costs.

For example, WorldVu Satellites Limited, LLC, doing business as OneWeb, proposes to deploy an innovative 700+ satellite constellation in low-Earth orbit to provide a wide range of communication services, including voice and broadband, for users worldwide.[176] The company has already received more than a billion dollars in investment[177] and broken ground on the construction of an $85 million high-volume satellite manufacturing factory in Florida.[178] OneWeb's first 10 satellites are scheduled to be launched at the end of this year, and the company expects to commence service in 2019.[179]

Telesat Canada, which also proposes to deploy a satellite broadband service, recently launched two satellites as part of the first phase of deployment for its 120-satellite constellation.[180] Similarly, Space Exploration Holdings, LLC, more commonly known as SpaceX, recently launched two experimental satellites for testing and data gathering to facilitate

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[176] *See* OneWeb Overview, http://onewebsatellites.com/#overview (last visited July 16, 2018).

[177] *See* Caleb Henry, *OneWeb Gets $1.2 Billion in SoftBank-led Investment*, SPACENEWS (Dec. 19, 2016), http://spacenews.com/oneweb-gets-1-2-billion-in-softbank-led-investment/.

[178] *See* Press Release, OneWeb, OneWeb Satellites Breaks Ground on the World's First State-of-the-Art High-Volume Satellite Manufacturing Facility (Mar. 16, 2017), http://oneweb.world/press-releases/2017/oneweb-satellites-breaks-ground-on-the-worlds-first-state-of-the-art-high-volume-satellite-manufacturing-facility.

[179] *See* Caleb Henry, *OneWeb shifts first launch to year's end*, SPACENEWS (May 1, 2018), https://spacenews.com/oneweb-shifts-first-launch-to-years-end/.

[180] *See* Kendall Russell, *Telesat Celebrates Launch of its First LEO Satellite*, VIA SATELLITE (Jan. 12, 2018), https://www.satellitetoday.com/business/2018/01/12/telesat-celebrates-launch-first-leo-satellite/.

development of its global, broadband constellation, which is expected to be comprised of more than 4,000 satellites.[181]

The Commission has already approved the application or U.S. market access request of each of those three prospective satellite operators.[182] If one or more of those satellite systems (or other similar systems) are deployed,[183] there will be even more competition in the mobile broadband market.

Mobile Satellite Services. Iridium Communications, Inc. ("Iridium"), an operational mobile satellite service ("MSS") provider, has deployed 55 of its next-generation "Iridium NEXT" satellites and expects to complete deployment of the remaining 20 satellites of the constellation by the end of the year.[184] Iridium NEXT is a $3 billion, mobile satellite constellation designed to provide high-speed broadband connectivity globally, and the completion of its deployment could provide additional competition to the wireless market.[185] Globalstar, Inc. ("Globalstar") has also proposed to operate a new terrestrial service using its satellite spectrum. In December 2016, the Commission granted Globalstar the authority to use

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[181] *See* Mike Wall, *SpaceX's Prototype Internet Satellites Are Up and Running*, SPACE.COM (Feb. 22, 2018), https://www.space.com/39785-spacex-internet-satellites-starlink-constellation.html.

[182] *See WorldVu Satellites Ltd., Petition for a Declaratory Ruling Granting Access to the U.S. Mkt. for the OneWeb NGSO FSS Sys.*, Order and Declaratory Ruling, 32 FCC Rcd 5366 (2017); *Telesat Canada, Petition for Declaratory Ruling to Grant Access to the U.S. Mkt. for Telesat's NGSO Constellation*, Order and Declaratory Ruling, 32 FCC Rcd 9663 (2017); *Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite Sys.*, Memorandum Opinion, Order and Authorization, 2018 WL 1559848 (Mar. 28, 2018).

[183] *See, e.g., Applications Accepted for Filing; Cut-off Established for Additional NGSO-like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*, Public Notice, 32 FCC Rcd 4180 (2017) (listing applications of other prospective satellite operators), https://docs.fcc.gov/public/attachments/DA-17-524A1.pdf.

[184] *See Iridium-7 Target Launch Date Announced* (June 15, 2018), http://investor.iridium.com/news-releases/news-release-details/iridium-7-target-launch-date-announced-0.

[185] *See id.*

an 11.5-megahertz portion of its MSS spectrum in the S-band frequencies (2483.5-2495 megahertz) for a terrestrial low-powered service.[186] And Ligado Networks LLC ("Ligado"), formerly LightSquared Subsidiary LLC, could offer terrestrial or a hybrid terrestrial/MSS service. Ligado received authority in 2004 to deploy a hybrid service in the 1.5 GHz and 1.6 GHz bands[187] and more recently sought authority to use 40 megahertz of those frequencies for the provision of terrestrial services.[188] CTIA has long advocated for measures that bring new spectrum to market and promote innovation, investment, and competition. The Commission should act promptly on Ligado's license modification request, which has remained pending for more than two and a half years, and provide clarity and certainty to the market.

Starry. Starry, Inc. ("Starry") has deployed pre-standard 5G, point-to-multipoint fixed wireless technology that it says will deliver gigabit-capable broadband to the home.[189] Starry uses millimeter waves for wireless last-mile gigabit broadband and offers consumers a no-contract, unlimited plan of $50 per month for 200 mbps download/upload.[190] Starry initially launched the service in the Boston market and expanded beta programs to Los Angeles and D.C. earlier this year.[191] Starry expects to launch its service in more than a dozen new markets in 2018.[192]

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[186] *See generally Terrestrial Use of the 2473.5-2495 MHz Band for Low-Power Mobile Broadband Networks, et al.*, Report and Order, 31 FCC Rcd 13801 (2016).

[187] *See generally Mobile Satellite Ventures Subsidiary LLC, Application for Minor Modification of Space Station License for AMSC-1, et al*., Order and Authorization, 19 FCC Rcd 22144 (2004).

[188] *See* Diana Goovaerts, *Ligado Networks renews 5G, IoT spectrum call*, MOBILE WORLD LIVE (Apr. 16, 2018), https://www.mobileworldlive.com/featured-content/top-three/ligado-networks-renews-5g-iot-spectrum-call/.

[189] *See* Press Release, Starry, Inc., Starry Announces Launch of Starry Internet in Los Angeles and Washington, DC (Jan. 4, 2018), https://bit.ly/2A8S3UB.

[190] *Id.*

[191] *Id.*

[192] *Id.*

All of these factors support the conclusion that a variety of new entrants, including cable and satellite providers, are poised to compete aggressively in the wireless marketplace.

V. COMPETITION TO LEAD IN 5G IS BOTH A NATIONAL AND INTERNATIONAL RACE.

A. 5G Will Deliver New Improvements Across Industry Verticals.

4G networks connected everyone; 5G networks will connect every*thing*. By enabling new applications such as autonomous vehicles and remote surgery, which require low latency, lightning-fast speeds, and increased capacity, 5G will enhance nearly every way we live, work, and communicate. For local communities, 5G networks will usher in new smart city applications that will allow cities to save money and be more efficient, optimize traffic and reduce emissions, and enhance public safety.[193] The predicted consumer benefits of smart grid adoption could total up to $2 trillion over the next 20 years, including more than $160 billion in estimated savings through 5G-generated reductions in energy use, fuel costs, and traffic congestion.[194] Wearables, sensors, and other Internet-connected devices will also transform the way we use mobile broadband networks. Indeed, the number of data-only non-phone connected devices has increased 147 percent over the last five years, to 126.4 million devices last year.[195]

5G applications and devices will drive radical improvements in how we communicate, travel, learn, and receive medical care.[196] Qualcomm CEO Steve Mollenkopf described 5G as "hav[ing] an impact similar to the introduction of electricity or the car; affecting entire

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[193] Jason Johnson, *How the Wireless-Powered Internet of Things Will Make Communities Even Smarter*, CTIA BLOG (Apr. 11, 2018), https://www.ctia.org/news/how-the-wireless-powered-internet-of-things-will-make-communities-even-smarter.

[194] *Id.*

[195] *See The State of Wireless 2018* at 10.

[196] *See* Letter from Scott K. Bergmann, Senior Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 14-177, *et al.* at 1 (filed Apr. 17, 2018); *see also* Section V.

economies and benefiting entire societies."[197] Intel estimates that by 2025 the total global worth of IoT technology could be as much as $6.2 trillion, with the majority of this value derived from devices deployed in the healthcare ($2.5 trillion) and manufacturing ($2.3 trillion) industries.[198]

5G networks will also spur further advances in health care for people with disabilities across the country.[199] Innovations like LG's Virtual Care Platform allows health care providers to engage 24/7 with their patients,[200] and innovative wearable technologies are also increasingly being used to monitor diseases.[201] These applications can help improve the lives of users with disabilities and foster their independence.

Along with delivering ultra-fast speeds, better scalability, lower latency, and higher reliability than previous generations of wireless,[202] 5G networks will also use new radio technology and embrace virtualization and associated innovations within the core network,

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[197] *See* Claire Reilly, *Qualcomm Says 5G Is the Biggest Thing Since Electricity*, CNET (Jan. 6, 2017), https://www.cnet.com/news/qualcomm-ces-2017-keynote-5g-is-the-biggest-thing-since-electricity/.

[198] *See* A Guide to the Internet of Things Infographic, INTEL, https://www.intel.com/content/www/us/en/internet-of-things/infographics/guide-to-iot.html (last visited July 13, 2018) (citation omitted).

[199] *See* Section II.B.

[200] LG Virtual Care, LG, https://healthcare.lgcns.com/solutions/virtual-care (last visited July18, 2018).

[201] The Kardia Band, for instance, is a Food and Drug Administration-cleared device designed to be used with the Apple Watch to monitor heart rhythms by placing the user's thumb on the band's sensor to take a medical-grade EKG in thirty seconds. *See KardiaBand*, ALIVECOR, https://www.alivecor.com/#kardiaband (last visited July18, 2018). Electronics manufacturer Kyocera recently announced that it is developing an algorithm for a sensor capable of detecting dehydration, heat stroke, or altitude sickness that can be incorporated in wearable devices or smartphones. *See Visualize Health Conditions Easily as a Daily Routine: Development of Compact Blood Flow Sensor using Optical Doppler Effect*, KYOCERA, https://global.kyocera.com/ecology/feature/feature01.html (last visited July18, 2018). And Nokia offers a portable blood pressure cuff; data from the cuff is automatically launched and provided in Nokia's Health Mate app, which can be uploaded via email to a user's health care provider. *See BPM Wireless Blood Pressure Monitor*, NOKIA, https://health.nokia.com/us/en/blood-pressure-monitor (last visited July.18, 2018).

[202] *Global race to 5G – Spectrum and infrastructure plans and priorities*, ANALYSYS MASON, at 10 (Apr. 2018), https://www.ctia.org/news/global-race-to-5g-spectrum-and-infrastructure-plans-and-priorities ("*Analysys Mason Report*").

creating a potential path for mobile networks to converge with cloud architectures to support today's broader IT ecosystem.[203]

B. The Wireless Industry is Competing for 5G Leadership in the U.S.

U.S. wireless providers and new entrants are competing to lead the nation's next generation of wireless connectivity. AT&T intends to commercially launch a mobile 5G service in 12 U.S. cities before the end of 2018, while Verizon has announced that it will launch residential fixed broadband 5G service in four U.S. markets in the fourth quarter of 2018. T-Mobile has indicated its intent to build out 5G service in 30 cities this year with commercial service available starting in early 2019 when the first 5G-capable smartphones come to market. Meanwhile, Sprint will bring 5G-like capabilities to six markets in 2018 and three additional markets in the first half of 2019 through its commercial deployment of massive MIMO technology. A mix of service providers trialed 5G in a combined 16 markets in 2017 and have announced plans to commercially deploy 5G in an estimated 27 distinct markets in 2018. By early 2019, the number of markets with 5G will grow to more than 30.[204]

Regional carriers are making strides as well. For example, U.S. Cellular and Ericsson conducted joint testing of 5G use cases over 28 GHz band spectrum in rural and suburban

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[203] *Id.*

[204] *See* Monica Alleven, *AT&T plans to launch mobile 5G in a dozen cities by late 2018*, FIERCEWIRELESS (Jan. 4, 2018), https://www.fiercewireless.com/wireless/at-t-plans-to-launch-mobile-5g-dozen-cities-by-late-2018; Press Release, T-Mobile US, Inc., T-Mobile Building Out 5G in 30 Cities This Year…and That's Just the Start (Feb. 26, 2018), https://www.t-mobile.com/news/mwc-2018-5g; *see also* Press Release, Sprint Corp., Sprint Announces New York City, Phoenix and Kansas City Among First to Experience Sprint 5G (May 15, 2018), http://newsroom.sprint.com/sprint-announces-new-york-city-phoenix-and-kansas-city-among-first-to-experience-sprint-5g.htm; Rayna Hollander, *Verizon just announced Los Angeles will be the second city to receive 5G*, BUSINESS INSIDER (May 18, 2018), http://www.businessinsider.com/verizon-5g-los-angeles-2018-5.

environments in Madison, Wisconsin throughout 2017.[205] The testing achieved peak speeds of 4 Gbps for virtual reality applications and included testing of other use cases such as augmented reality, advanced beamforming and massive MIMO.[206] The live, over-the-air trials expanded prior testing between the two companies in 2016.[207]

In addition to traditional mobile network operators, new entrants are moving quickly to deploy 5G networks. Charter Communications is testing 5G fixed wireless service in six markets using 3.5 GHz band spectrum.[208] Comcast is reportedly conducting field testing of 5G service as well.[209] Starry launched this year its 200 Mbps "pre-standard 5G, point-to-multipoint fixed wireless" service in three markets and plans to expand into a total of 16 markets by the end of 2018.[210] Even non-telecom companies like Facebook are investing in 5G—Facebook has partnered with several firms including Deutsche Telekom, SK Telecom, Intel, and Nokia through its Telecom Infra Project to accelerate 5G research and development.[211]

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[205] *See* Press Release, U.S. Cellular Corp., U.S. Cellular Expands 5G Tests with Ericsson to 28 GHz (Oct. 24, 2017), https://www.uscellular.com/about/press-room/2017/USCellular-EXPANDS-5G-TESTS-WITH-ERICSSON-TO-28GHZ.html.

[206] *Id.*

[207] *Id.*

[208] *See* Juan Pedro Tomás, *Charter Communications testing 5G in six U.S. markets*, RCRWIRELESS (Jan. 29, 2018), https://www.rcrwireless.com/20180129/5g/charter-communications-testing-5g-in-us-tag23.

[209] *See* Daniel Frankel, *Comcast's Watson: "We're very confident in our ability to compete" with 5G*, FIERCECABLE (Apr. 27, 2018), https://www.fiercecable.com/cable/comcast-s-watson-we-re-very-confident-our-ability-to-compete-5g.

[210] Mike Dano, *Starry to Expand Its $50/200 Mbps Fixed Wireless Service to 16 Major Markets During 2018*, FIERCEWIRELESS (Jan. 4, 2018), https://www.fiercewireless.com/5g/starry-to-expand-its-50-200-mbps-fixed-wireless-service-to-16-major-markets-during-2018.

[211] Sean Kinney, *Facebook Telecom Infra Project hones 5G focus*, RCRWIRELESS (Nov. 8, 2017), https://www.rcrwireless.com/20171108/5g/facebook-telecom-infra-project-5g-tag17; Michael Reilly, *Facebook Enters the Race to Build 5G Networks*, MIT TECHNOLOGY REVIEW (Feb. 22, 2016), https://www.technologyreview.com/s/600875/facebook-enters-the-race-to-build-5g-networks/.

Technology companies play an integral role in the 5G race. Just this month, Qualcomm unveiled the first millimeter wave 5G antennas for smartphones, and the company says it will launch the first devices as early as the beginning of next year.[212] Ericsson, Samsung, Nokia, Intel, and others are enabling deployments for the national operators as they roll out 5G network equipment. Each of these companies has been conducting major trials and tests with all four national operators and regional operators including U.S. Cellular and others.

C. The Global Race to 5G is Real, And the Consequences of Winning or Losing are Substantial.

U.S. companies are not only competing against one another to deploy 5G and capture market share but also against telecommunications firms and new entrants in other countries around the world. The global race is on, and the winners will secure the economic and consumer welfare benefits that will come from mass deployment of 5G.

Currently, the U.S. ranks third in the world for 5G readiness according to one recent study.[213] China ranks narrowly ahead of South Korea and the U.S. as the most 5G-ready nation based on an index of key factors such as spectrum availability, infrastructure policies, and industry investment.[214] Nations around the world are targeting additional spectrum for 5G services. China's regulatory authority has committed to release at least 100 megahertz of mid-band spectrum, and two gigahertz of high-band spectrum, for each mobile network operator in the country.[215] Likewise, Japan, South Korea, Italy, Spain, and the U.K. will each make

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[212] Chaim Gartenberg, *Qualcomm unveils first mmWave 5G antennas for smartphones*, THE VERGE (July 23, 2018), https://www.theverge.com/2018/7/23/17596746/qualcomm-mmwave-5g-antenna-smartphones-qtm052-networking-speeds-size.

[213] *See The Global Race to 5G*.

[214] *Id*. at 6.

[215] *Id*. at 7.

additional spectrum available for 5G in 2018 (or 2019, in the case of Japan).[216] Recent auctions in South Korea[217] and Spain[218] of mid-band spectrum are evidence that others are racing to enable 5G networks. Meanwhile, the U.S. ranked sixth out of 10 countries recently studied with respect to mid-band spectrum availability for 5G services.[219] Countries are also streamlining zoning processes for small cell deployments and funding 5G research initiatives.[220]

The Commission has embraced the global race to 5G and has committed to ensuring U.S. leadership. As Chairman Pai has succinctly put it, when it comes to 5G "if you ain't first, you're last."[221] Commissioner Carr described the stakes earlier this year:

> Countries around the world are vying to be first. They want to see the capital necessary for 5G deployments invested in their parts of the world. They want consumers in their countries at the front of the line when it comes to realizing the benefits of 5G. And countries from Europe to Asia are already moving aggressively in this space.[222]

Advancing 5G networks is also a goal of Commissioner O'Rielly, who previously explained that "[l]eading the world in 5G will allow U.S. companies to help shape its future growth, standards, and capabilities—all of which have tremendous impact on our future

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[216] *Analysys Mason Report* at 17-18.

[217] *See, e.g.*, Iain Morris, *South Korea's 5G Auctions Raises $3.3B*, LIGHTREADING (June 19, 2018), https://www.lightreading.com/mobile/spectrum/south-koreas-5g-auction-raises-$33b/d/d-id/744066.

[218] *See, e.g.*, Juan Pedro Tomás, *Spanish 5G spectrum auction raises $469 million after four rounds*, RCRWIRELESS (July 25, 2018), https://www.rcrwireless.com/20180725/5g/spectrum-auction-spain-tag23.

[219] *The Global Race to 5G* at 11.

[220] *See Analysys Mason Report* at 21.

[221] Ajit Pai, Chairman, FCC, Remarks at the Wireless Infrastructure Association Connectivity Expo at 2 (May 23, 2018).

[222] Brendan Carr, Commissioner, FCC, Remarks at CTIA's Race to 5G Summit: "Next Steps on the Path to 5G," at 2 (Apr. 19, 2018).

economic success."[223] Commissioner Rosenworcel agrees that "[t]he race to 5G is on and other countries are working to seize the mantle of wireless leadership."[224]

The Commission's enthusiasm and interest in winning the race to 5G is well founded. History shows that failing to create an adequate regulatory environment for a next-generation technology could have long-term, systemic effects.

Europe provides a cautionary tale. Europe had the most advanced 2G networks in the world, and as a result captured significant market share for network equipment, operating systems, and handsets.[225] Europe's leadership in 2G resulted in hundreds of thousands of jobs and billions in economic impact.[226] But Europe fell behind in the deployment of 4G LTE and lost its position as a world leader as a result. The European Commission subsequently found that, while it held approximately 80 percent of the mobile equipment market in 2008, it lost almost its entire market share because the EU was not ready for 4G mass deployment.[227] Despite efforts to reverse those negative trends for 5G, European nations still significantly trail in the 5G race.[228] Japan experienced a similar dynamic in the evolution from 3G to 4G.[229]

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[223] Michael O'Rielly, Commissioner, FCC, Remarks before the American Enterprise Institute, at 1 (Apr. 19, 2018).

[224] Jessica Rosenworcel, *It's time to chart a course for 5G success*, TECHCRUNCH (Jan. 10, 2018), https://techcrunch.com/2018/01/10/its-time-to-chart-a-course-for-5g-success/.

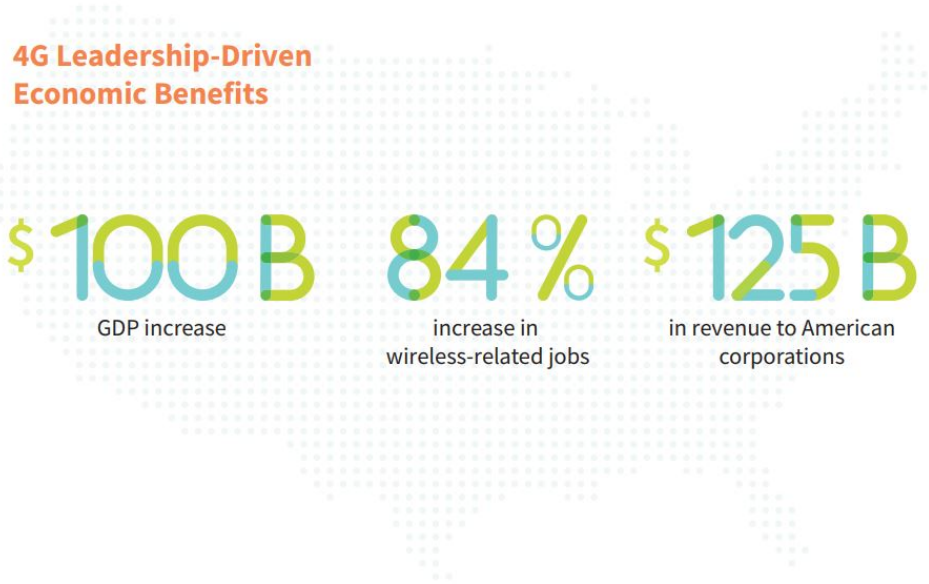
[225] *See The Global Race to 5G* at 5.

[226] *See id.*

[227] *See id.*

[228] *See id.*

[229] *See id.*



Meanwhile, the U.S. led the world in 4G and reaped the economic rewards of doing so. According to an analysis from Recon Analytics, the U.S. wireless industry GDP grew from $195.5 billion in 2011 to $332.9 billion in 2014, when 4G reached 40 percent penetration in the U.S.[230] By 2016, the realized effects on U.S. GDP of 4G networks had exceeded projected effects of 3G networks by almost $100 billion.[231]

America's 4G leadership created benefits beyond GDP growth. In the 3G era, total core wireless (direct, indirect, and support) jobs grew four percent, from 2.4 million in 2004 to 2.5 million in 2011.[232] In the years between 2011 and 2014, when wireless carriers deployed 4G, core wireless jobs grew 84 percent.[233] Winning the 4G race helped secure America's leading position in key parts of the global wireless ecosystem, including the app economy. Further, the

[230] *How America's Leading Position in 4G Propelled the Economy*, RECON ANALYTICS, at 9 (Apr. 16, 2018), https://api.ctia.org/wp-content/uploads/2018/04/Recon-Analytics_How-Americas-4G-Leadership-Propelled-US-Economy_2018.pdf.

[231] *Id.*

[232] *Id.* at 10.

[233] *Id.*

retail cost of mobile wireless data consumption has dropped precipitously over the past decade based on the network cost efficiencies of 4G.

D. Smart Government Policies Can Secure the U.S. Position.

America's ability to maintain its current leadership in 4G deployment through the transition to 5G will depend in significant part on the rules and policies the Commission and other stakeholders adopt in the near-term.

First, mobile network operators need additional spectrum—particularly mid-band spectrum—to maintain and improve America's position in the global 5G race. CTIA applauds the Commission for committing to auction 28 GHz and 24 GHz band spectrum starting this year.[234] The forthcoming auctions are key steps in securing the U.S. lead in 5G. The agency's recently announced commitment to auction the 37 GHz, 39 GHz, and 47 GHz bands next year will further ensure a steady stream of high-band spectrum coming to market to support the new technologies, services, and more robust data usage 5G will enable.[235]

In addition to these key bands coming to market, the Commission should also take action to ensure that additional millimeter wave bands are made available for exclusive licensed terrestrial wireless use. As discussed further below, CTIA also encourages the Commission to finalize its rules for the 3.5 GHz band and schedule that spectrum for auction, fast-track its rulemaking for the 3.7-4.2 GHz band, and work with NTIA on exploration of the 3450-3550 MHz band for potential commercial use.[236]

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[234] *See Auctions of Upper Microwave Flexible Use Licenses for Next-Generation Wireless Services*, Draft Public Notice, AU Docket No. 18-85, FCC-CIRC-1808-1 ¶ 2 (rel. July 12, 2018) ("*Spectrum Frontiers Auction 101 (28 GHz) and Auction 102 (24 GHz) Public Notice*").

[235] Ajit Pai, *Coming Home*, FCC BLOG (July 11, 2018), https://www.fcc.gov/news-events/blog/2018/07/11/coming-home ("*Pai July 11, 2018 Blog Post*").

[236] *See Promoting Investment in the 3550-3700 MHz Band, et al.*, Notice of Proposed Rulemaking and Order Terminating Petitions, 32 FCC Rcd 8071 (2017); *Expanding Flexible Use of the 3.7 to 4.2 GHz*

Second, siting reforms are critical to quickly deploying 5G infrastructure. As networks transition from 4G to 5G, the number of small cells will grow exponentially, from 13,000 small cells deployed in 2017 to 86,000 in 2018—a 550 percent increase—and over 800,000 by 2026.[237] Removing barriers to accessing public rights-of-way and government-owned infrastructure, harmonizing shot clocks and adopting effective remedies for the entire siting process, and ensuring that wireless technologies can be efficiently deployed at cost-based, transparent, and non-discriminatory rates will allow America's mobile network operators to continue to invest in and timely initiate 5G service.[238]

VI. COMPETITION, INVESTMENT, AND INNOVATION SUPPORT THE WIRELESS INDUSTRY'S EFFORTS TO PROTECT CONSUMERS.

Wireless providers value the privacy and security of their customers. Individually and through CTIA, service providers have implemented a range of measures to ensure the security of their customer's devices, accounts, data, and personal information. They have also made strides to protect consumers from illegal and unwanted robocalls and worked to improve public safety capabilities to keep consumers safe in emergencies, and are working with key stakeholders to reduce the number of contraband devices that make their way into our nation's inmate facilities. The competitive marketplace for mobile broadband services ensures that providers will continue to deliver results in all these areas to meet their customers' expectations. This section highlights a small sample of these important efforts.

Band, et al., Order and Notice of Proposed Rulemaking, FCC 18-91, WT Docket Nos. 17-183 and 18-122 (rel. July 13, 2018).

[237] *See The State of Wireless 2018* at 20.

[238] *See* Section VII.

A. Security, Data Protection, and Device Theft Deterrence are Priorities.

Protecting their customers' mobile devices against theft and security breaches remains a top priority for the wireless industry. Wireless providers work hard to protect their customers' data and personal information. Wireless providers adhere to responsible privacy and data security practices, which are outlined and made available to their customers in detailed privacy policies.[239] Additionally, wireless providers voluntarily commit to enforceable self-regulatory codes of conduct, including privacy principles regarding transparency, consumer choice, data security, and notification.

The nationwide wireless providers have also developed a variety of tools and security features to assist customers in securing their devices, accounts, and information. CTIA recently published a new white paper, "Protecting America's Next Generation Networks,"[240] which provides an update on wireless security by addressing new enhancements that 5G standards and technology will bring to wireless consumer. Smart phones increasingly offer advanced

[239] *See, e.g.*, Privacy Policy, Southern Linc Wireless, https://www.southernlinc.com/privacy/privacy-policy.aspx (last visited July 19, 2018); Privacy and Acceptable Use Policy, Cellcom, https://www.cellcom.com/privacy.html#privacy (last visited July 19, 2018); Cellular One Privacy Policy, Cellular One, http://www.cellularoneonline.com/uploads/media/files/CELLULAR%20ONE%20PRIVACY%20POLICY%20(Final%201%20Draft%202018)_.pdf (last visited on July 19, 2018).

[240] *See Protecting America's Next-Generation Networks*, CTIA (July 2, 2018), https://www.ctia.org/news/protecting-americas-next-generation-networks.

technologies, such as biometric scanning and facial recognition, for controlling access to the device and the data it stores.[241] Many providers also offer multi-factor authentication and other security features that allow customers to set a PIN or security question that the customer uses to improve the security of his or her accounts, including purchases and interactions with the company.[242]

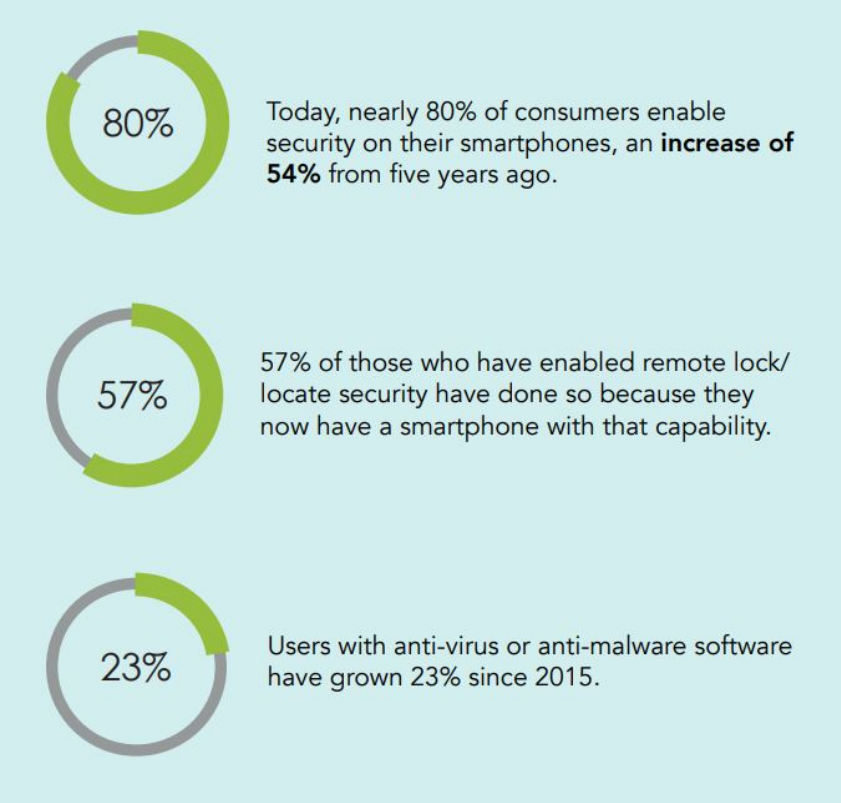
The wireless industry works hard to educate customers and make them aware of all available tools. For example, Southern Linc provides customers with information on securing mobile devices at every level, including physical protection, passcode locking, and a variety of apps that can provide higher levels of security.[243] Bluegrass Cellular is also educating its customers on using extra care when engaging in mobile banking activities, an area where security is especially crucial.[244] CTIA also

[241] *See, e.g.*, David Gilbert, *Which Biometric Authentication Method Is Most Secure?*, SAMSUNG (Mar. 1, 2018), https://insights.samsung.com/2018/03/01/which-biometric-authentication-method-is-most-secure-2/.

[242] *See, e.g.*, Learn more about your account PIN, Sprint, https://www.sprint.com/en/support/solutions/account-and-billing/learn-more-about-your-account-pin.html (last visited July 11, 2018); Account Pin FAQs, Verizon, https://www.verizonwireless.com/support/account-pin-faqs/ (last visited July 11, 2018); Add or Remove Extra Security, AT&T, https://www.att.com/esupport/article.html#!/wireless/KM1051397 (last visited July 11, 2018).

[243] *See* Frequently Asked Questions about Cell Phone Security, Southern Linc, https://www.southernlinc.com/faqs/faqs-phone-security.aspx (last visited July 19, 2018).

[244] *See* Support FAQs: Mobile Security, Bluegrass Cellular, https://bluegrasscellular.com/support/faq?q=Is+mobile+banking+safe%3F (last visited July 19, 2018).



works to educate consumers on available tools and best practices.[245] Some wireless providers also make an effort to engage specifically with senior citizens and the accessibility community to promote data protection and device theft deterrence. Verizon, for example, has conducted training sessions to teach seniors how to use their smartphones to communicate, while protecting themselves from becoming victims of online scams. These industry efforts are paying off; approximately 80 percent of smartphone users enable security features, an increase of over 50 percent from five years ago.[246]

In addition to these efforts, the wireless industry continues to work hard to help deter the theft of mobile devices. In May 2017, CTIA launched stolenphonechecker.org, a website that allows consumers to determine if a mobile phone has been reported lost or stolen before purchasing it, thus reducing incentives to steal phones.[247] This initiative builds on earlier efforts

[245] *See, e.g.*, Consumer Resources, Protecting Your Privacy, CTIA, https://www.ctia.org/consumer-resources/protecting-your-privacy (last visited July 23, 2018).

[246] *Protecting America's Wireless Networks*, CTIA, at 9 https://api.ctia.org/docs/default-source/default-document-library/protecting-americas-wireless-networks.pdf (Apr. 2017).

[247] Press Release, CTIA, U.S. Wireless Industry Launches Free Consumer Tool to Combat Smartphone Theft (May 11, 2017), https://www.ctia.org/news/us-wireless-industry-combats-smartphone-theft.

like the "Smartphone Anti-Theft Voluntary Commitment" that CTIA, along with several wireless providers and manufacturers, created in July 2015.[248] Companies voluntarily entering into this commitment agreed to offer certain protections to consumers in the event of loss or theft,[249] such as the ability to remotely wipe smartphones and render the devices inoperable. Applications such as Find My iPhone also work to deter theft by allowing consumers to track the location of their device.[250]

B. The Wireless Industry Has Made Strides to Mitigate Illegal Robocalling.

CTIA strongly supports the Commission's efforts to help reduce illegal and unwanted calls from bad actors. Carriers are using network-based techniques, leveraging the proliferation of apps and other third-party tools, educating consumers, deploying call authentication technology, and collaborating with aggregators, innovators, and regulators. The ecosystem has seen tremendous growth in the capabilities that carriers and consumers have available to combat illegal robocalling.

The Commission deserves credit for helping to facilitate innovation and collaboration. The Commission has recognized the importance of consumer choice, affirming that "nothing in the Communications Act or our rules or orders prohibits carriers or VoIP providers from implementing call-blocking technology that can help consumers who choose to use such technology to stop unwanted robocalls."[251] This recognition of consumer choice in stopping

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[248] Smartphone Anti-Theft Voluntary Commitment, CTIA, https://www.ctia.org/the-wireless-industry/industry-commitments/smartphonea-anti-theft-voluntary-commitment (last visited July 11, 2018).

[249] *Id.*

[250] *See* If your iPhone, iPad, or iPod touch is lost or stolen, Apple, https://support.apple.com/en-us/HT201472 (last visited July 20, 2018).

[251] *Rules and Regulations Implementing the Telephone Consumer Protection Act of 1991*, Report and Order, 30 FCC Rcd. 7961 ¶ 152 (2015) (internal citations omitted). It continued that "[c]onsumers

unwanted robocalls, along with other Commission actions, has helped to facilitate innovation in the app space, paved the way for carriers to further enhance consumer choice, and led to a proliferation of activity, including industry driving emerging call authentication protocols and the Commission authorizing additional, limited blocking activity.

Industry jump-started efforts to defeat the scourge of robocalls by establishing the Industry Robocall Strike Force in 2016. As the Commission has recognized, "[t]he Strike Force made significant progress toward arming consumers with call blocking tools and identifying ways voice providers can proactively block illegal robocalls before they ever reach the consumer's phone,"[252] and the Strike Force was an impetus for the Commission's Call Blocking Order.[253] The Strike Force has prompted carriers to develop new technologies, improve data analytics, increase collaboration, and educate consumers. As recently reported in the *Wall Street Journal*: "Service providers have upped their robocall-protection offerings recently."[254] Among other things, the industry:

- Collectively blocks millions of robocalls per day.[255] Indeed, between October 2016 and June 2018, AT&T alone blocked 3.9 billion illegal calls from being delivered to

currently have the choice to use call-blocking technology to block individual numbers or categories of numbers, and may continue to do so." *Id.*

[252] *Advanced Methods to Target and Eliminate Unlawful Robocalls*, Notice of Proposed Rulemaking and Notice of Inquiry, 32 FCC Rcd 2306 ¶ 7 (2017).

[253] *Advanced Methods to Target and Eliminate Unlawful Robocalls*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 9706 ¶¶ 5-7 (2017) (noting that ("[t]he Strike Force specifically asked the Commission to provide guidance on when providers may block a call that the provider believes is illegal" and then "sought [additional] clarification that: (1) providers may block calls where the Caller ID shows an unassigned number; and (2) providers may block calls that the provider has determined to be illegal robocalls, so long as the provider takes reasonable steps to confirm that the calls are illegal").

[254] *See, e.g.*, Katherine Bindley, *Why Are There So Many Robocalls? Here's What You Can Do About Them*, WALL ST. J. (July 4, 2018), https://www.wsj.com/articles/why-there-are-so-many-robocalls-heres-what-you-can-do-about-them-1530610203?mod=searchresults&page=1&pos=1&ns=prod/accounts-wsj.

[255] CTIA Ex Parte Notice, CG Docket No. 17-59; WC Docket No. 17-97 (filed Jan. 23, 2018) ("*CTIA January 2018 Ex Parte*").

customers. T-Mobile's Scam ID has resulted in more than three billion scam calls tagged since launch.

- Is adopting new call blocking and spam call prediction tools for customer use.
- Continues to leverage the capabilities of the app industry. App platforms have seen a 495 percent increase in the number of available call blocking apps between October 2016 and March 2018. Carriers recognize that third-party robocall prevention apps can be effective and empowering for consumers.
- Continues to focus on consumer education. CTIA has updated its webpage devoted to increasing awareness of robocall prevention tools and providing consumers instructions on how to stop robocalls.[256] CTIA and its members have participated in federal agency outreach to consumers as well.
- Is partnering with standards bodies like the Alliance for Telecommunications Industry Solutions, Inc. ("ATIS") IP-NNI Task Force and SIP Forum on the SHAKEN/STIR call authentication framework.[257]
- Assists the FTC and the FCC with law enforcement's investigations against robocallers and maintains relationships with call fraud bureaus that may initiate investigations after a suspected mass illegal robocalling event.[258]

Carriers and partners in the ecosystem—such as app developers—have also created tools that empower consumers to block illegal robocalls. For example:

- **AT&T**. AT&T rolled out a service called "Call Protect" to allow customers with iPhones and HD Voice enabled Android handsets to automatically block suspected fraud calls. In addition, AT&T offers AT&T Digital Call Protect for IP wireline phones.
- **Sprint.** Sprint has partnered with Cequint to enhance its Premium Caller ID product that allows customers to subscribe to an optional, paid service that empowers them to receive information about the type of caller that is attempting to reach them and to set up preferences to send those calls to voicemail or to block them entirely, category by category.
- **T-Mobile**. T-Mobile's Scam ID and Scam Block are automatic, network-based services offered free of charge that allow customers to immediately see when calls come in from likely scammers, and to block all likely scammers before they reach the consumer. These tools were rolled out in March 2017 to address the growing problem of fraudulent and unwanted calls. T-Mobile also has DNO blocking, both on its network and within the PrivacyStar solution.

[256] CTIA, How to Stop Robocalls, https://www.ctia.org/consumer-resources/how-to-stop-robocalls/ (last visited July 23, 2018).

[257] *CTIA January 2018 Ex Parte*.

[258] *Id*.

- **U.S. Cellular**. U.S. Cellular is currently offering all Android and iOS customers a device application that offers free and premium robocall identification and blocking capabilities. The application—Call Guardian—protects U.S. Cellular customers by revealing the names of non-malicious callers who are not in the called party's contacts. The free subscription identifies incoming calls with the highest risk/toxicity scores for free. Alternatively, the premium subscription identifies callers of all risk levels, and offers the subscriber the option to block calls based on the caller's identified risk level.
- **Verizon**. Verizon has deployed and continues to expand robocall mitigation features as part of its Caller Name ID service, including a spam filter that forwards to voicemail any calls corresponding to the spam risk level selected by the customer. And Verizon's Spam Alerts provide wireline customers who have Caller ID—whether they are on copper or fiber—with enhanced warnings about calls that meet Verizon's spam criteria by showing the term "SPAM?" before a caller's name on the Caller ID display.

Additionally, data analytics providers are developing an array of sophisticated analytics engines that help subscribing carriers and customers to identify calls that are likely to be illegal or unwanted.

The wireless industry has also made significant progress developing a standardized system for caller ID authentication to combat caller ID spoofing, often associated with illegal robocalls: SHAKEN/STIR are leading edge cryptographic protocols and operational procedures to authenticate calls and mitigate spoofing and associated illegal robocalling. SHAKEN—which stands for "**S**ignature-based **H**andling of **A**sserted information using to**KEN**s"—and STIR—which stands for "**S**ecure **T**elephone **I**dentity **R**evisited"—were industry-developed through a consensus process led by ATIS and the SIP Forum. These protocols will enable "verif[ication] and authenticat[ion] [of] caller identification for calls carried over an Internet Protocol (IP) network."[259] The North American Numbering Council's Call Authentication Trust Anchor

[259] *Robocall Strike Force Report* at 3 (Oct. 26, 2016).

Working Group recently supported SHAKEN/STIR,[260] and carriers and others in the ecosystem are committed and are in the process of deploying SHAKEN/STIR.[261]

To continue this significant progress, the Commission and the Federal Trade Commission ("FTC") should keep bringing enforcement actions against bad actors. Doing so not only helps deter future bad actors, but also increases the costs of illegal activity through a "whole of government" approach. Finally, the agencies should lead international efforts to thwart illegal operations and to change norms and evangelize call authentication protocols, which need to be deployed globally.

C. Wireless Services are a Cornerstone of Public Safety Communications Tools for Consumers During Emergencies.

Recognizing the increasingly important role of mobile wireless services during emergencies, CTIA's member companies are more committed than ever to deploying robust and resilient wireless services and networks that millions of consumers rely on before, during, and after storms, natural disasters, and other widespread emergencies. Every year, more people turn to their mobile device to reach 9-1-1.

For many years, wireless network operators have designed, deployed, and managed robust, resilient networks using a regional approach to tailor their deployments and restoration plans as appropriate for various environments. For example, in the Southern U.S., operators design their networks specifically for hurricanes, flooding, and other related disasters; in California, they design networks for earthquakes and wildfires. Similarly, restoration plans and assets are positioned based on specific network deployments as well as associated disaster relief

[260] *Report on Selection of Governance Authority and Timely Deployment of SHAKEN/STIR*, NANC Call Authentication Trust Anchor Working Group (May 3, 2018) ("*CATA-WG Report*").

[261] *See* Comments of CTIA, CG Docket No. 17-59, at 8-9 (filed July 20, 2018).

plans. Because carriers proactively applied lessons learned from previous emergencies and used the flexible approach outlined in the Wireless Network Resiliency Cooperative Framework,[262] wireless services were more widely available, improved safety, and enhanced coordination for millions of consumers during the historic 2017 hurricane season.

Indeed, as hurricanes struck Texas, Louisiana, Florida, Mississippi, Alabama, the U.S. Virgin Islands, and Puerto Rico in 2017, millions of consumers were able to rely on mobile wireless services when they needed it the most. As the City of Houston observed in response to a Public Notice issued last year on response efforts undertaken during the 2017 hurricane season,[263] the Houston Emergency Center received 60,000 9-1-1 calls in one day during Hurricane Harvey (a Category 4 storm), which represents a ten-fold increase over the typical number of daily calls the center receives on average.[264] In Florida, Miami-Dade County officials urged residents to use mobile apps for shelter, power outage, gas station, and traffic updates during and after Hurricane Irma. And in Puerto Rico and the U.S. Virgin Islands, where Hurricanes Maria and Irma devastated critical infrastructure, wireless services were available to 74 percent of Puerto Ricans and 93 percent of U.S. Virgin Islanders by early November of 2017, despite the fact that just 43 percent of Puerto Ricans and less than 25 percent of U.S. Virgin Islanders had access to commercial power at that time.[265] The extensive resiliency and

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[262] *Improving the Resiliency of Mobile Wireless Communications Networks; Reliability and Continuity of Communications Networks, Including Broadband Technologies*, Order, 31 FCC Rcd 13745 (2016) (establishing a voluntary cooperative framework for enhanced coordination during emergencies).

[263] *Public Safety and Homeland Security Bureau Seeks Comment on Response Efforts Undertaken During 2017 Hurricane Season*, Public Notice, 32 FCC Rcd 10245 (2017) ("*2017 Hurricanes Response Efforts PN*").

[264] City of Houston Comments, PS Docket No. 17-344, at 4 (Jan. 22, 2018).

[265] FCC, *Communications Status Report for Areas Impacted by Hurricane Maria*, at 2-3 (Nov. 6, 2017), https://docs.fcc.gov/public/attachments/DOC-347526A1.pdf; U.S. Department of Energy, *Hurricanes Maria & Irma, November 6 Event Summary (Report #74)*, at 2-3 (Nov. 6, 2017),

restoration practices of wireless providers, along with the flexible approach of the Wireless Cooperative Framework, proved instrumental in achieving these results during the unprecedented conditions presented by the 2017 storms.

The Framework in particular proved effective in enhancing service continuity and information sharing during and immediately after these historic storms and helped wireless providers restore service as quickly as possible when cell sites went down. Looking ahead to the 2018 hurricane season and beyond, the wireless industry continues to take additional steps consistent with the Wireless Cooperative Framework to further bolster resiliency and preparedness.

Wireless providers have also taken steps to enhance public safety capabilities, including 9-1-1 and Wireless Emergency Alerts ("WEAs"). For example, wireless providers have enhanced their 9-1-1 location accuracy technologies consistent with the FCC's 2015 *Report and Order*,[266] including by establishing a 9-1-1 Location Technologies Test Bed.[267] The Test Bed is rigorously evaluating new technologies under real-life conditions and has demonstrated that device-based hybrid solutions perform well in traditionally challenging environments, such as indoor dense urban areas. Wireless providers are also investing in new capabilities, like the National Emergency Address Database, to support the availability of dispatchable location information.[268] Wireless providers recognize and are committed to providing robust innovative

https://www.energy.gov/sites/prod/files/2017/11/f46/Hurricanes%20Maria%20and-%20Irma%20Event%20Summary%20November%206%2C%202017_0.pdf.

[266] *See Wireless E911 Location Accuracy Requirements*, Fourth Report and Order, 30 FCC Rcd 1259 ¶ 116 (2015).

[267] *See Stage Z: Altitude, Z-Axis Testing for Indoor Location Technologies*, 911 Location Technologies Test Bed LLC, http://www.911locationtestbed.org/Stage_z.html (last visited July 12, 2018).

[268] *See* NEAD, The National Emergency Address Database, www.911nead.org (last visited July 20, 2018).

9-1-1 services, especially as more than 70 percent of the approximately 240 million calls made to 9-1-1 in 2017 were wireless calls.[269]

Since 2012, more than 36,000 life-saving WEAs have been sent to warn consumers of imminent threats, such as hurricanes, flooding, wildfires, and terrorism events. Wireless providers that voluntarily support the WEA capability have continued to enhance the capabilities available to alert originators, including cell-site geo-targeting and embedded links, with additional enhancements becoming available in May 2019, such as expanding the character limit to 360, "opt in" testing, and Spanish language support.[270] As noted in recent comments to the Commission, CTIA and its member companies are eager to work with the alert originator community, Federal Emergency Management Agency, and the Commission to develop best practices that can help alert originators fully utilize the existing and forthcoming capabilities of WEA.[271]

Wireless providers continue to support and improve Text-to-911 services by working with device manufacturers to deploy RTT functionality. Since 2015, all U.S. wireless providers have supported text-to-911 services.[272] Text-to-911 has already helped save lives across the United States.[273] RTT-to-RTT calling, RTT-to-911 calling, and RTT-to-TTY calling can be

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[269] Robert Roche, *Celebrating 50 Years of 9-1-1*, CTIA BLOG (Feb. 14, 2018), https://www.ctia.org/news/celebrating-50-years-of-9-1-1.

[270] *See* Lisa M. Fowlkes, *Wireless Emergency Aelrts: An Update*, FCC BLOG (April 10, 2018), https://www.fcc.gov/news-events/blog/2018/04/10/wireless-emergency-alerts-update.

[271] Comments of CTIA, PS Docket No. 15-91 (filed May 29, 2018).

[272] Press Release, CTIA, Wireless Industry Announces Latest Step Toward Enhancing Mobile 911 Location Services (Oct. 4, 2016), http://www.ctia.org/policy/policy-position-details/policy-subtopic-details/911-Public-Safety/text-to-911.

[273] *See* Tyler Jones, *Text to 911 Rescues Lost California Man*, KEZI (Mar. 20, 2018), http://www.kezi.com/content/news/Text-to-911-rescues-lost-California-man-477462433.html; Kaitor Kay, *Text to 911 growing quickly across Indiana*, WANE (June 19, 2018), https://www.wane.com/news/local-news/text-to-911-growing-quickly-across-indiana/1247959171; Carol

particularly crucial for consumers in need of alternative accessibility options.[274] As consumers who are deaf, hard of hearing, and speech-impaired increasingly adopt innovative wireless services, including Text-to-911, the wireless industry will continue to support the transition toward more advanced solutions like RTT.

VII. THE COMMISSION CAN FOSTER FURTHER GROWTH AND COMPETITION IN THE WIRELESS MARKETPLACE BY MODERNIZING ITS SITING RULES AND INCREASING ACCESS TO SPECTRUM RESOURCES.

Consistent with the RAY BAUM'S Act's mandate to address legal and regulatory barriers to entry into the communications marketplace, including barriers for entrepreneurs and small businesses,[275] the *Public Notice* requested comment on such barriers in the wireless marketplace. Although the mobile wireless marketplace remains robustly competitive, further efforts are needed at all levels of government to reduce regulatory barriers and ensure wireless services can be rapidly and efficiently deployed to the benefit of the economy, businesses, and consumers.

CTIA commends the Commission for the significant progress it has made in reducing the legal and regulatory burdens hindering entry into the mobile wireless marketplace, particularly in connection with the National Historic Preservation Act ("NHPA") and National Environmental Policy Act ("NEPA") review[276] and eliminating rules that place unnecessary burdens on

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Ann Alaimo, *Text-to-911 coming to Tucson area, will help disabled, give voice call option*, ARIZONA DAILY STAR (July 17, 2018), https://tucson.com/news/local/text-to--coming-to-tucson-area-will-help-disabled/article_60b649bb-ba2f-55bb-ba09-c77b076eda91.html.

[274] *See* Matthew Gerst and Kara Graves, *Real Time Text is Wireless Accessibility for the 21st Century*, CTIA BLOG (Feb. 12, 2018), https://www.ctia.org/news/real-time-text-is-wireless-accessibility-for-the-21st-century.

[275] *See* Consolidated Appropriations Act, 2018, Pub. L. No. 115-141, Div. P—RAY BAUM'S Act of 2018, §§ 401-404, 132 Stat. 348, 1087-90 (2018) ("RAY BAUM'S Act of 2018").

[276] *See Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment*, Second Report and Order, FCC 18-30, WT Docket No. 17-79 (rel. Mar. 30, 2018).

licensees.[277] These reforms are reducing costs, shortening deployment time, enhancing competitiveness, and accelerating America's pace towards 5G leadership. CTIA also appreciates the Commission's progress towards bringing additional mid- and high-band spectrum to auction for licensed mobile broadband use and finalizing the 2015 CBRS licensing rules. Making available as much spectrum as possible is crucial to achieving 5G leadership.

However, more efforts are needed at all levels of government to reduce regulatory barriers and ensure that wireless services can be rapidly and efficiently deployed to the benefit of the economy, businesses, and consumers. In particular, the Commission should vigorously work to eliminate barriers to wireless infrastructure deployment and to free up additional spectrum for wireless use.

A. Reducing Barriers to Wireless Infrastructure Deployment Will Enable the Competitive Roll-Out of Infrastructure to Support Improved and New Next-Generation 5G Networks.

Wireless networks and infrastructure have evolved in the past two decades, and wireless siting rules should be modernized to reflect these changes. 5G will require the use of small cells, which can be installed in about an hour.[278] But under rules designed decades ago for 200-foot cell towers, it can take more than a year to get the necessary government approvals.[279] Accenture estimates small cell deployments will escalate rapidly—from roughly 13,000

[277] *See, e.g.*, *Amendment of Parts 1 and 22 of the Commission's Rules with Regard to the Cellular Service, Including Changes in Licensing of Unserved Area, et al.*, Third Report and Order, FCC 18-92 (rel. July 13, 2018); *Amendments to Harmonize and Streamline Part 20 of the Commission's Rules Concerning Requirements for Licensees to Overcome a CMRS Presumption*, Report and Order, 32 FCC Rcd 10731 (2017); *Section 43.62 Reporting Requirements for U.S. Providers of International Service; 2016 Biennial Review of Telecommunications Regulations*, Report and Order, 32 FCC Rcd 8115 (2017).

[278] Kelly Cole, *Modern Rules Are Needed to Build Our Wireless Future*, CTIA BLOG (June 28, 2018), https://www.ctia.org/news/modern-rules-are-needed-to-build-our-wireless-future.

[279] *Id.*

deployed in 2017 to over 800,000 deployed by 2026.[280] As Commissioner Carr noted: "The record is clear . . . We need a major upgrade to our infrastructure deployment rules."[281]

The Commission should be applauded for the steps it has already taken to reduce barriers to infrastructure deployment and update outdated policies for new networks, starting in December 2017 with steps regarding replacement poles and the long outstanding Twilight Tower issue. In March, the Commission took a significant step in right-sizing its environmental and historic preservation policies for next-generation network technologies. This action was significant. Indeed, Accenture estimates that the exclusion of small cells from historic preservation and environmental reviews will reduce the cost to deploy 5G networks over the next eight years by $1.56 billion.[282]

The Commission's proposed declaration at the forthcoming August Open Meeting that state and local moratoria on telecommunication services and facilities deployment—whether express or *de facto*, interim or permanent—are barred under the Act[283] would be another welcome step given that numerous localities and states have erected such barriers.[284] As CTIA

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[280] *Impact of Federal Regulatory Reviews on Small Cell Deployment*, ACCENTURE STRATEGY, at 3 (Mar. 12, 2018), https://api.ctia.org/docs/default-source/default-document-library/small-cell-deployment-regulatory-review-costs_3-12-2018.pdf ("*Accenture Small Cell Report*").

[281] Remarks of FCC Commissioner Brendan Carr, Consumer Technology Association's 5G Day, "Ensuring the United States is 5G Ready" (Feb. 28, 2018), https://docs.fcc.gov/public/attachments/DOC-349499A1.pdf.

[282] *Accenture Small Cell Report* at 4-5.

[283] *See Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment*, *Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment*, Draft Third Report and Order and Declaratory Ruling, WC Docket No. 17-84, WT Docket No. 17-79, FCC-CIRC1808-03 (rel. July 13, 2018) (proposing to conclude that state and local moratoria, whether express or *de facto*, on telecommunication services and facilities deployment are barred by Section 253(a) of the Act) ("*Draft Third Wireless Infrastructure Reform R&O*"); *see also* 47 U.S.C. § 253(a).

[284] *See, e.g.*, *Draft Third Wireless Infrastructure Reform R&O* ¶ 133 (quoting Comments of AT&T Services, Inc., WC Docket No. 17-84, at 74 (filed June 15, 2017), describing how an Ohio municipality enacted a 145-day moratorium on permits for construction in rights-of-way and how an Illinois city

has stated, there is no more absolute prohibition on deployment than refusing to accept or act on applications. A local law that bars acceptance of applications and a local agency's refusal to act on them have precisely the same impact—no deployment—and they are thus *per se* unlawful.

As the Commission now pivots to addressing local siting issues beyond moratoria, an important step would be for the Commission to clarify that any state or local law or practice that poses a substantial barrier to timely deployment of broadband facilities violates Sections 253 and 332(c)(7) of the Act.[285] Congress enacted these provisions to promote network deployment. Unfortunately, divergent court decisions interpreting each of these provisions have created uncertainty as to their scope and application.[286] A declaratory ruling would resolve this uncertainty.

There are several additional concrete steps that the Commission can take to facilitate 5G deployment and promote competition. First, the Commission should strengthen the shot clock under Section 332 of Act and adopt a "deemed granted" remedy for all facilities applications not processed within a certain period, and clarify that these shot clocks and the deemed granted remedy apply to the entire local review process.[287] This would prevent unreasonable delays. Second, the Commission should clarify that fees must be cost-based, non-discriminatory, and transparent in order not to run afoul of the Act.[288] Finally, the Commission should provide

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imposed a five-year moratorium on pavement cuts to roadways that have been resurfaced or reconstructed); *id.* ¶ 133 (citing Letter from Ronald W. Del Sesto, Jr., Counsel, Uniti Fiber, to Marlene H. Dortch, Secretary, FCC, WC Docket No. 17-84, WT Docket No. 17-79, at Exh. A (filed Oct. 30, 2017), identifying 44 jurisdictions in Florida that have implemented wireless infrastructure moratoria).

[285] *See* 47 U.S.C. §§ 253(c), 332(c)(7).

[286] *See, e.g.*, *City of Arlington v. FCC*, 668 F.3d 229 (5th Cir. 2012), *aff'd*, 133 S. Ct. 1863 (2013); *Sprint Spectrum, LP v. Willoth*, 176 F.3d 630, 643 (2d Cir. 1999).

[287] *See* 47 U.S.C. § 332(c)(7).

[288] 47 U.S.C. § 253(c).

guideposts regarding practices that violate Sections 253 and 332 of the Act, which would offer clarity to industry and localities.[289] Specifically, the Commission should determine that denials of access to municipally owned utility poles and other structures, requirements that all facilities along rights-of-way be underground, requirements to prove a service coverage gap or other business need, and subjective, unreasonable, or unpublished aesthetic restrictions are prohibited under the Act and the Commission's implementing regulations. These types of regulations or requirements, along with many others, have the effect of substantially delaying or deterring service, and should be prohibited.

Finally, CTIA supports resolution of the issues involving Twilight Towers as proposed in the Commission's Draft Program Comment.[290] The Commission's approach would promote rapid broadband deployment by making Twilight Towers available for collocation while also protecting historic preservation interests.

B. The Commission Can Promote Competition Among Wireless Providers By Allocating Additional High-, Mid-, and Low-Band Spectrum for Exclusive Licensed Use.

Freeing up spectrum and making it available to mobile broadband providers is the linchpin for winning the race to 5G and ensuring robust competition. CTIA applauds recent Commission efforts to ensure the U.S. is 5G-ready, including the upcoming auctions of the 28 GHz band (Auction 101), which will start on November 14, 2018, and the 24 GHz band (Auction 102),[291] and the Chairman's proposal to auction three more millimeter-wave spectrum bands—

[289] *See* 47 U.S.C. §§ 253, 332.

[290] *Comment Sought on Draft Program Comment for the Federal Communications Commission's Review of Collocations on Certain Towers Constructed Without Documentation of Section 106 Review*, Public Notice and Draft Program Comment, 32 FCC Rcd 10715 (2017).

[291] *See Spectrum Frontiers Auction 101 (28 GHz) and Auction 102 (24 GHz) Public Notice* ¶ 2.

the 37 GHz, 39 GHz, and 47 GHz bands—in the second half of 2019.[292] These are important steps. Additional high-band spectrum in the 26 GHz, 29 GHz, 31 GHz, 32 GHz, 42 GHz, and 50 GHz bands should also be considered for flexible mobile use. The 26 GHz band, in particular, is promising given its proposed use for 5G on the international stage.[293] The faster the Commission acts to identify which of these bands can be repurposed for 5G use, the faster all carriers will have an opportunity to acquire millimeter wave spectrum for new low-latency and high-bandwidth 5G applications.

The U.S. must also work to free up valuable mid-band spectrum for 5G use as quickly as possible, just as other nations around the world are doing. China reserved spectrum in the 3.3-3.6 GHz band for 5G use in 2017,[294] and South Korea just concluded an auction for spectrum in the 3.6-3.7 GHz band.[295] In Europe, Germany plans to auction spectrum from 3.4-3.7 GHz for nationwide use later this year.[296] Seeking prompt resolution of several ongoing proceedings, however, could help the Commission quickly close the gap with these other countries.

First, revising the CBRS rules to adopt larger license sizes, ten-year license terms, and an expectation of renewal will foster additional competition among carriers, promote economies of

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[292] *Pai July 11, 2018 Blog Post*.

[293] For example, South Korea recently closed an auction of 26.5-29.5 GHz band for 5G use and carriers are looking to launch commercial deployments in 2019, and China has been studying the 24.25-27.5 GHz band for 5G services. *See, e.g.*, *MSIT Announces Results of 5G Spectrum Auction*, TELEGEOGRAPHY (June 19, 2018) ("*MIST Announces Results of 5G Auction*"), https://www.telegeography.com/products/commsupdate/articles/2018/06/19/msit-announces-results-of-5g-spectrum-auction/; *5G in China: Outlook and Regional Comparisons*, GSMA, at 27 (2017), https://www.gsmaintelligence.com/research/?file=67a750f6114580b86045a6a0f9587ea0&download ("China is also assessing spectrum needs in the millimeter wave band for extremely high data rate requirements in hotspot areas, and has consulted on frequency planning in the 24.75-27.5 GHz, 37-42.5 GHz and other millimeter wave bands for 5G.").

[294] *Analysys Mason Report* at 32.

[295] *See MIST Announces Results of 5G Auction.*

[296] *Analysys Mason Report* at 32.

scale, and maximize long-term investment in the 3.5 GHz band.[297] Second, fast-tracking the repurposing of the 3.7-4.2 GHz spectrum, including maximizing the amount of spectrum available for mobile broadband, setting aggressive timelines for a final decision, and pushing stakeholders to work collaboratively, will provide U.S. mobile broadband providers access to spectrum targeted for 5G use globally.[298] Finally, working with NTIA to identify additional bands, such as the 3450-3550 MHz band, for potential repurposing from government use to commercial wireless use will be critical to meeting the spectrum requirements of the Mobile Now Act.[299]

Low-band spectrum continues to serve as the cornerstone of effective 4G LTE coverage and the bedrock of any nationwide wireless network deployment, and as noted above, it will serve as an important piece in the 5G puzzle. The propagation characteristics of low-band spectrum allow operators to offer coverage that travels long distances, penetrates walls to provide indoor connectivity, and reaches urban canyons.

Maintaining the 39-month transition timeline following the close of the incentive auction will ensure that 600 MHz spectrum is in the hands of mobile operators—and deployed to

[297] *See Promoting Investment in the 3550-3700 MHz Band*, Notice of Proposed Rulemaking and Order Terminating Petitions, 32 FCC Rcd 8071 (2017) (seeking comment on several proposed changes to the rules governing Priority Access Licenses including longer license terms, renewability, and larger geographic licenses).

[298] *See Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Order and Notice of Proposed Rulemaking, GN Docket No. 18-122, FCC 18-91 (rel. July 13, 2018) (seeking comment on adding a mobile allocation for the entire 3.7-4.2 GHz band that would enable the band to be transitioned for more intensive fixed and flexible uses).

[299] David J. Redl, *NTIA Identifies 3450-3550 MHz for Study as Potential Band for Wireless Broadband Use*, NTIA BLOG (Feb. 26, 2018), https://www.ntia.doc.gov/blog/2018/ntia-identifies-3450-3550-mhz-study-potential-band-wireless-broadband-use.

consumers—as quickly as possible, and will avoid significant opportunity costs.[300] One study estimates that the annual loss of consumer surplus associated with even a one-year delay will approximate the total revenue from the auction.[301] By contrast, tower-related efforts and broadcaster repacking can be accomplished in a timely and cost-effective manner.[302] T-Mobile, the biggest winner in the 600 MHz auction, has been spending considerable resources deploying its 600 MHz spectrum in advance of broadcaster transition deadlines;[303] the Commission should do everything in its power to ensure that 600 MHz licensees are able to continue down this path.

VIII. THE COMMISSION SHOULD REAFFIRM ITS CONCLUSION THAT THE WIRELESS MARKET IS EFFECTIVELY COMPETITIVE.

In its *Twentieth Report*, the Commission correctly concluded that there is effective competition in the market for the provision of mobile wireless services.[304] That conclusion was an appropriate implementation of Section 332(c)(1)(C) of the Act, and was the only reasonable conclusion that could be drawn from the pervasive evidence of vibrant competition in the mobile wireless marketplace. The Commission properly noted that Section 332(c)(1)(C) does not define "effective competition" nor dictate a particular methodology for assessing effective

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[300] *See, e.g.*, Coleman Bazelon & Giulia McHenry, *Staying on Track: Realizing the Benefits from the FCC's Incentive Auction Without Delay*, THE BRATTLE GROUP (Feb. 20, 2015), *reproduced in* Comments of LocusPoint Networks, LLC, AU Docket No. 14-252 (filed Feb. 20, 2015) ("*Staying on Track: Realizing the Benefits from the FCC's Incentive Auction Without Delay*").

[301] *Staying on Track: Realizing the Benefits from the FCC's Incentive Auction Without Delay* at 9.

[302] *See* T-Mobile USA, Inc., Broadcast Tower Technologies, Inc. and Hammett & Edison, Inc., On Time and On Budget: Completing the 600 MHz Incentive Auction Repacking Process Within the FCC's 39-Month Relocation Deadline and the Budget Established By Congress (Feb. 17, 2016), *attached to* Letter from Steve Sharkey, Vice President, Government Affairs Technology and Engineering Policy, T-Mobile USA, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-268, AU Docket No. 14-252 (filed Feb. 17, 2016).

[303] *See, e.g.*, Ben Munson, *CBS, T-Mobile Already Finished a 600 MHz Repack in New York*, FIERCECABLE (July 9, 2018), https://www.fiercecable.com/video/cbs-t-mobile-already-finished-a-600-mhz-repack-new-york-city.

[304] *Twentieth Report* ¶ 4.

competition.[305] Nonetheless, the Commission acknowledged numerous "facts and characteristics of the provision of mobile wireless services" that, taken together, indicated the presence of effective competition.[306]

As established above, the mobile wireless marketplace continues to be characterized by effective competition along every relevant dimension. Whatever specific methodology the Commission uses to assess competition today, it should acknowledge two realities. First, consumers continue to enjoy myriad benefits that reflect robust competition, including faster speeds, improved network quality, greater choices among plans and devices, and multiple options for service providers. Second, structural indicators likewise reflect effective competition, including increases in demand and output, substantial network investment, aggressive implementation of new spectrum bands, significant ongoing innovation highlighted by the laser focus on 5G, and new entry from well-capitalized entities such as cable operators. With these and other indicia of competition in mind, the only plausible conclusion is that the mobile wireless market remains highly competitive. The Commission accordingly should report to Congress that competition in the marketplace for the provision of mobile wireless services is effectively competitive.

[305] *Id.* ¶ 3.

[306] *Id.* ¶ 4.

IX. CONCLUSION.

As discussed in more detail above, competition in the mobile wireless marketplace is robust and growing. The wireless market continues to display vibrant competition along every relevant dimension, including expanded service coverage and offerings, the continuous deployment of new technologies, and new entry by well-capitalized competitors—to the benefit of the American economy, businesses, and consumers. Accordingly, CTIA urges the Commission to reaffirm its conclusion and report to Congress that competition in the provision of mobile wireless services is effective.

Respectfully submitted,

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Appendix A

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The State of Wireless

2018

Introduction

Welcome to CTIA's 2018 State of Wireless report, a comprehensive look at the key facts and figures that tell the story of America's wireless industry.

It's a remarkable story—one of American ingenuity, innovation, and investment combining to create a world-leading wireless ecosystem that powers the U.S. economy.

It's also a story of human connections: the phone calls, the text messages, and the video chats. Wherever you are, wireless keeps you connected to the important people in your life.

Wireless continues to improve every day. Mobile speeds are faster than ever. Coverage continues to expand, even in challenging-to-serve rural areas. Mobile devices pack more power and capabilities. All the while, fierce competition drives prices down.

This year, our story is also one of change. Thanks to our industry's investment in technology—and the people that power it—we'll see the first 5G networks by the end of 2018. America's wireless industry moves fast. It's a momentous development.

With 4G, the wireless industry connected everyone. As we look to next-generation 5G networks, we're connecting everything.

You can see that in the growing number of cell sites and data-only devices this year, as well as in the number of consumers and businesses looking to wireless to transform our communities and our economy.

But as the transition to 5G begins, other countries are doing everything they can to seize our global leadership—and the associated economic benefits.

While America's wireless industry is leading the way on 5G efforts, policymakers must act during this critical inflection point to reform local zoning rules, unlock more spectrum, and create conditions that will speed nationwide deployment.

America's Wireless Industry

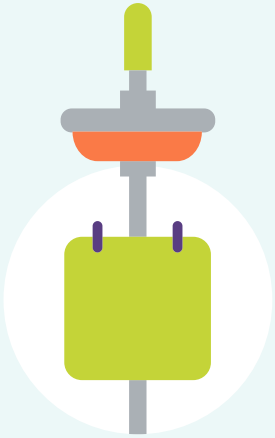
A Story of Remarkable Growth and Transformation

Since 1985, CTIA has tracked the evolution of the U.S. wireless industry with our wireless industry survey. During this time, we've seen remarkable growth and significant changes as we moved from analog voice to high-speed mobile connectivity.

This year is no exception as the wireless industry continues to grow and set new records for network traffic, wireless connections, and network infrastructure deployment.

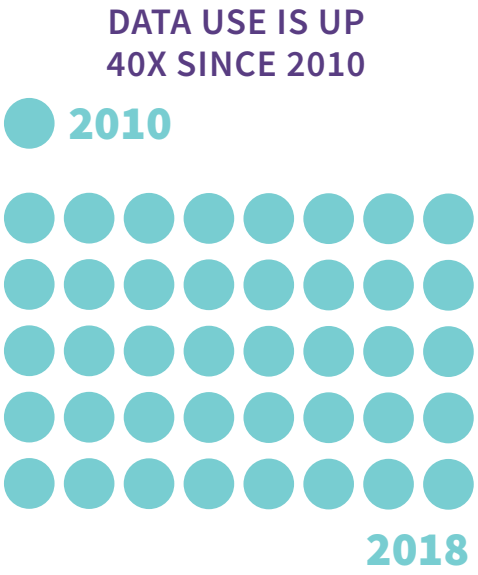
Indeed, this year's report shows the industry on the cusp of another transformation. The mobile and fixed 5G services launching in 2018 will build upon the 4G efforts and network densification that the U.S. wireless industry has undertaken in the past few years—setting the foundation for our 5G future.

Let's dive into the numbers.

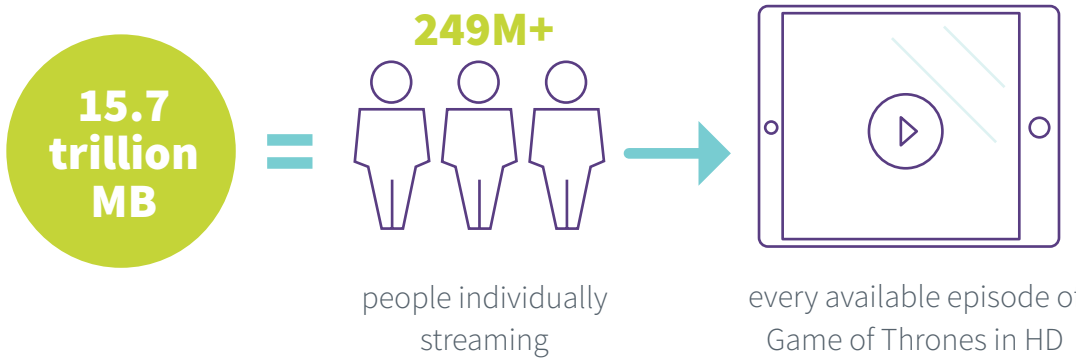


Wireless data use in the U.S. continues to soar.

Year over year, data use has trended up as Americans embrace the power of wireless connectivity. In just the last year, we saw an additional **2 trillion MB cross our networks.**



Consumers set another record year for wireless data use in 2017 as demand for everything wireless continues to grow. We saw **over 15 trillion MB** carried over U.S. wireless networks last year, which is another annual record.



SMARTPHONE ECOSYSTEM

400M+

mobile devices, that's about

1.2 devices
for every person in the country

of those devices,

273M

are data-intensive smartphones

that's equal to **82%** of the U.S. population

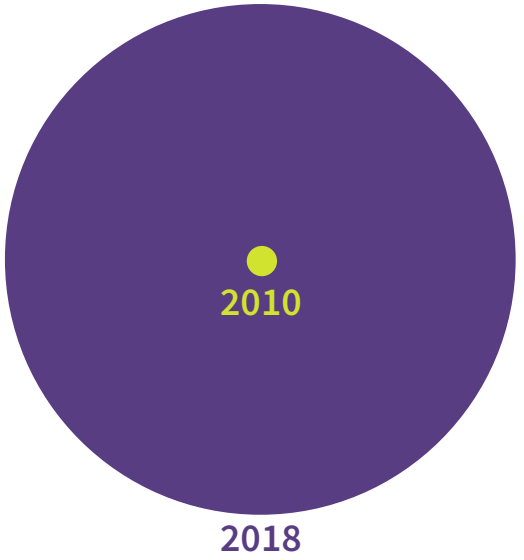
Up 56%
over the last ten years

Driving this growth is a decades-long and continuing increase in the number of mobile devices. With over 400 million mobile devices, there are more wireless devices than Americans—in fact, about 1.2 devices for every person in the country.

More than 68% of these devices are data-intensive smartphones. On average last year, a smartphone generated more than 5 GB of data every month. This represents a 2,844% increase since 2010 as networks have become faster, phones have become more sophisticated, and new services and apps have launched.

5GB

of data generated by a smartphone each month



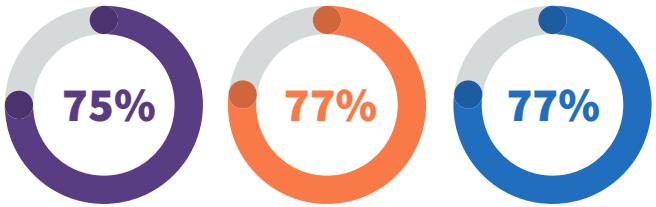
+2,844%
more data since 2010

Smartphone adoption is up across all demographics, well on its way to becoming ubiquitous and reflecting our mobile-first lives.

Millennials lead smartphone adoption. In the U.S., smartphones are owned by:[1]

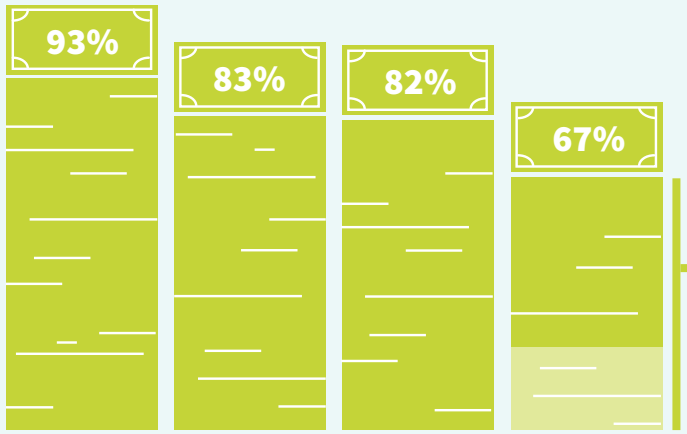
of 18–29 year olds | of 30–49 year olds | of 50–64 year olds

With respect to race, smartphone ownership cuts across the board, including:[1]



of African-Americans | of Hispanics | of whites

Across income levels, a significant majority of Americans now have smartphones:[2]

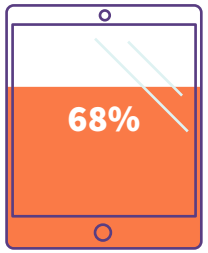


ANNUAL EARNINGS

Since 2011, the percentage of adults making under $30,000 per year who own a smartphone has tripled, growing from 22% to 67%.[3]

We're using wireless more—and relying on mobile connectivity in more ways.

We first used mobile phones to make calls on the go, then came text messaging for quick messages, photos, and videos. Today, Americans are using their wireless devices for even more.[4]



68% of Americans are doing more with their mobile service now than they were five years ago, including:

- Mobile banking
- Health apps
- Browsing the web
- Shopping
- Finding entertainment
- Connecting with their car and home
- And more

American businesses rely on wireless more than ever, viewing this connectivity as a strategic resource for their companies and employees.

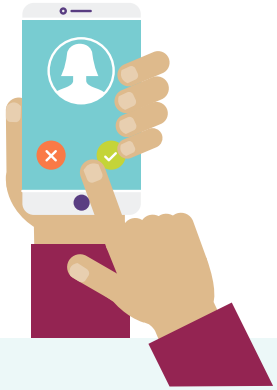
of executives view wireless technology as important to their business today[5]

Even as consumers and businesses adopt new applications and view wireless in new ways, text/SMS/MMS and voice calls continue to be of great importance to how we communicate.

The equivalent of 56,000 messages every second of an entire year

Consumers exchanged
1.77 trillion messages
(combined SMS and MMS) in 2017.

Consumers also spent
2.2 trillion minutes
talking on their mobile devices through traditional voice services.

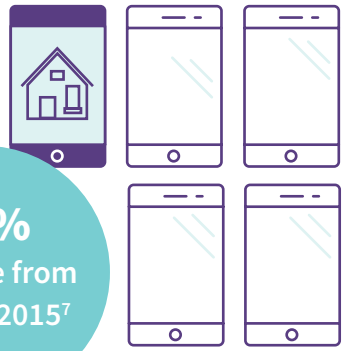


More people are cutting the cord and going wireless-only, making mobile their sole telephone connection. Over half of U.S. households rely only on mobile for their voice connection.

52.5%

of American households have only a mobile voice connection[6]

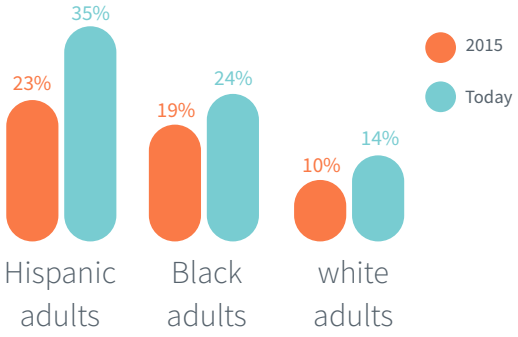
Americans are also increasingly relying entirely on mobile wireless at home. **One in five now rely only on their smartphone for home Internet access.**



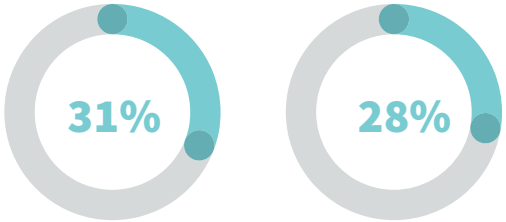
54%
increase from 13% in 2015[7]

This trend is particularly true among Hispanics, African-Americans, young adults, and low-income individuals.

Own smartphones but don't have a wired home broadband connection[8]



Do not have a wired home broadband connection but do have a smartphone[9]

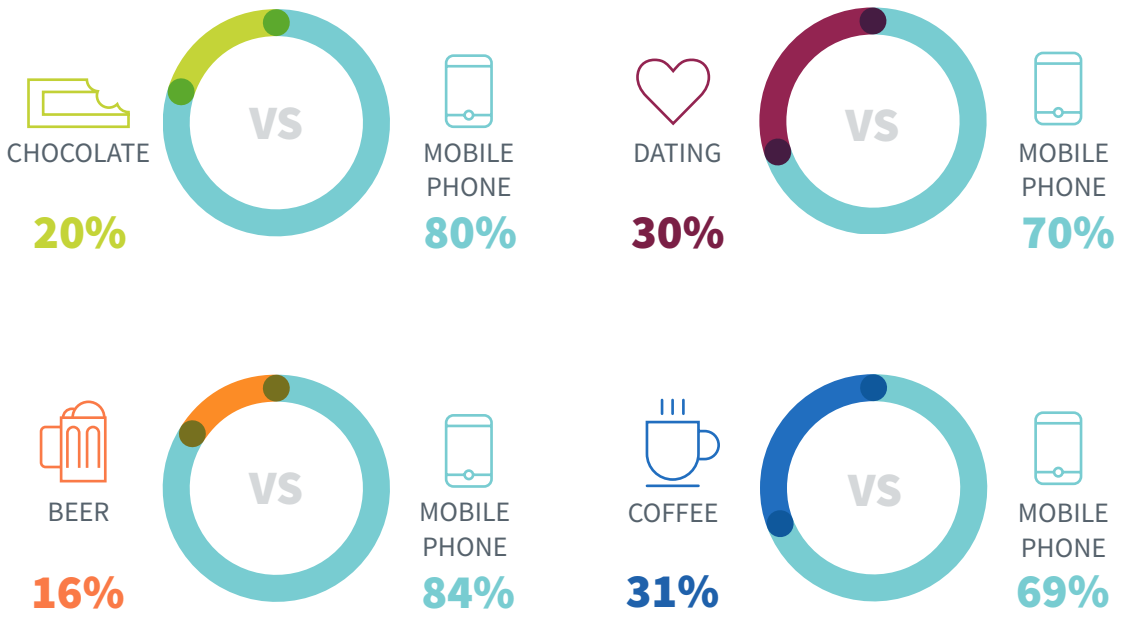


of adults making under $30k per year

of adults aged 18–29

Just how important has mobile become to us? More and more Americans are saying they would choose their mobile phone over other popular products or activities.[10]

GIVEN THE CHOICE, AMERICANS WOULD CHOOSE:



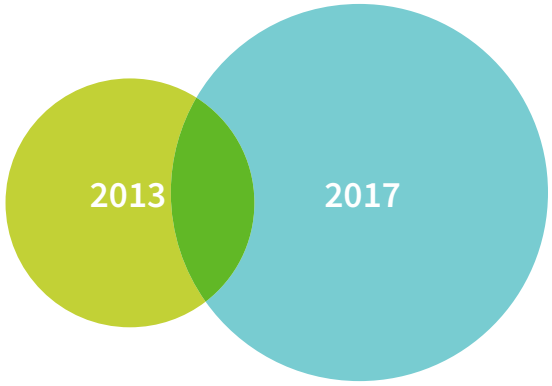
Not just a phone anymore—wireless connectivity is evolving.

This is the year that 5G networks will begin to be deployed. And for the first time, we're capturing signs of a shift from the 4G era to the 5G era.

While we continue to see growth in our traditional industry metrics, we're starting to see—for the first time—indicators that show us moving from an industry that connects *everyone* to an industry that connects *everything*. One of these indicators is the strong growth in the number of data-only devices.

The number of non-phone connected devices reached 126.4 million last year. In fact, 90% of new net-adds in 1Q18 came from areas like connected cars and the IoT.[11]

TOTAL REPORTED DATA-ONLY DEVICES



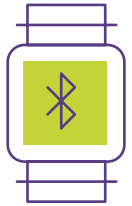
+147%
in the last five years

+19.5%
from 2016-2017 alone

These data-only devices are installed in connected cars, homes, and public and private infrastructure, including both business and consumer products.

Health and fitness monitors

Cellular-connected IoT devices



Smartwatches

And other connected devices

This future is just beginning. A fully enabled and deployed Internet of Things promises to improve nearly everything, from grocery shopping to transportation systems—all through the power of wireless connectivity.

> *"The industrial Internet of Things … is one of the most important national interests we have … There's going to be 50 billion inter-connected devices [and this] will lead to increased economic growth, job creation, and greater human safety."*
>
> — Michael Fitzpatrick,
> Head of Regulatory Advocacy, GE

Industry Investment and Innovation Driving Wireless Today and Tomorrow

This story of growth is made possible due to the industry's remarkable investment in infrastructure, technology, and people.

WIRELESS CAPITAL EXPENDITURES

More than **$226 billion invested** since 4G networks were launched in 2010

$25.6B
in 2017 alone

These expenditures are made to keep up with consumer demand and invest in tomorrow's networks.

In addition to capital expenditures, the wireless industry has also spent billions of dollars on spectrum licenses. Licensed spectrum is a key resource for the industry to provide secure, reliable coverage across the U.S.

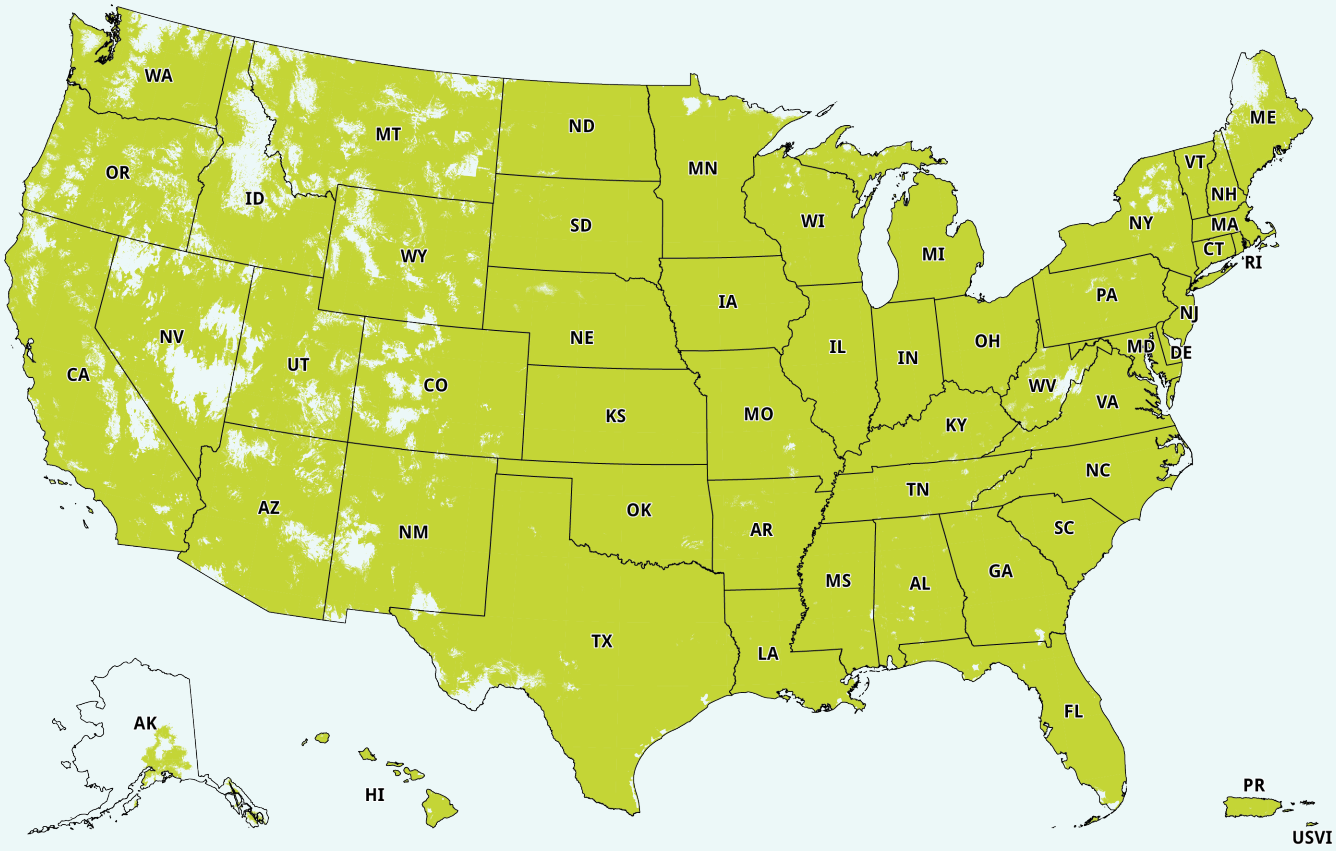
Since 1994, FCC spectrum auctions have raised over $114 billion in revenue for the government.[12]

The results of these capital and spectrum investments are clear: **continuous improvements in coverage and better mobile experiences.**

Wireless coverage continues to expand.

The first 4G networks were rolled out in the U.S. in 2010. Today—just seven years later—**these high-speed mobile networks cover 99.7% of all Americans**. And 98% of all Americans have a choice of three or more mobile service providers, according to the FCC.[13]

4G LTE COVERAGE IN 2017



Over the past five years, more than 1.5 million additional rural Americans have been covered by mobile broadband.

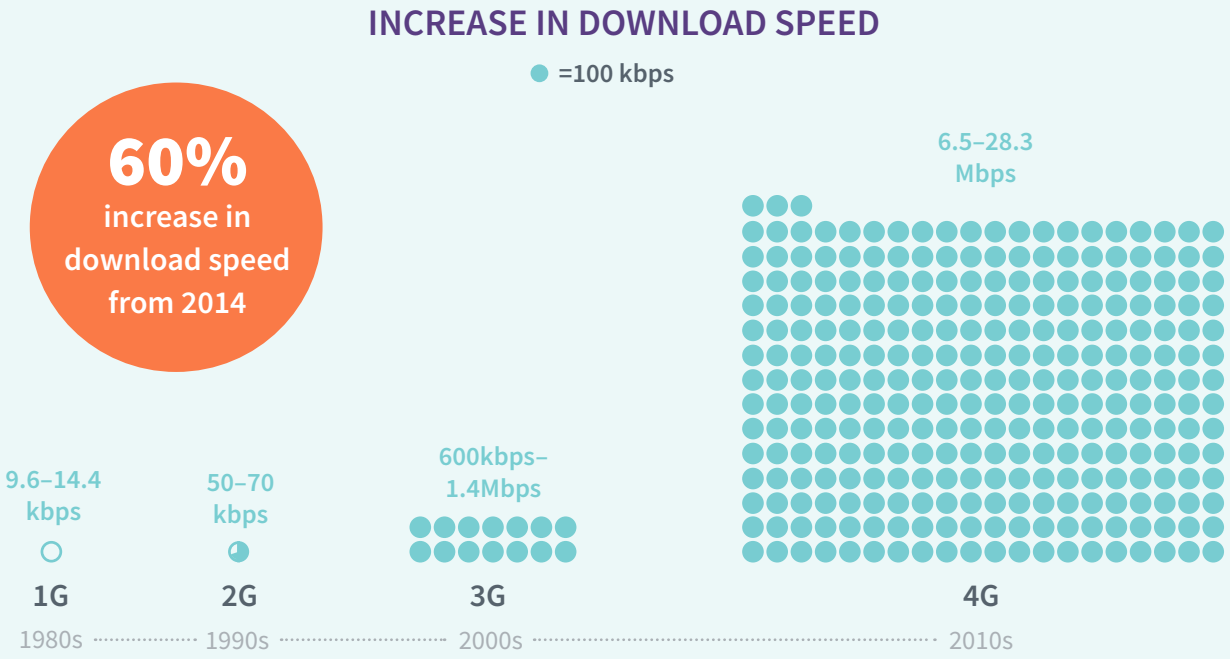
This coverage supports American businesses, students, healthcare providers, and others across the country, providing the connectivity for whatever their wireless needs may be.

> *"Wireless has been a tremendous help to our farming operation, because it's keeping me connected anywhere on the farm … 4G LTE has impacted the business because the transmission speeds, the data speeds are much faster. We're able to incorporate that into technology and our equipment to make better decisions."*
>
> — Shane Wells
> Owner, Mockingbird Hill Farms

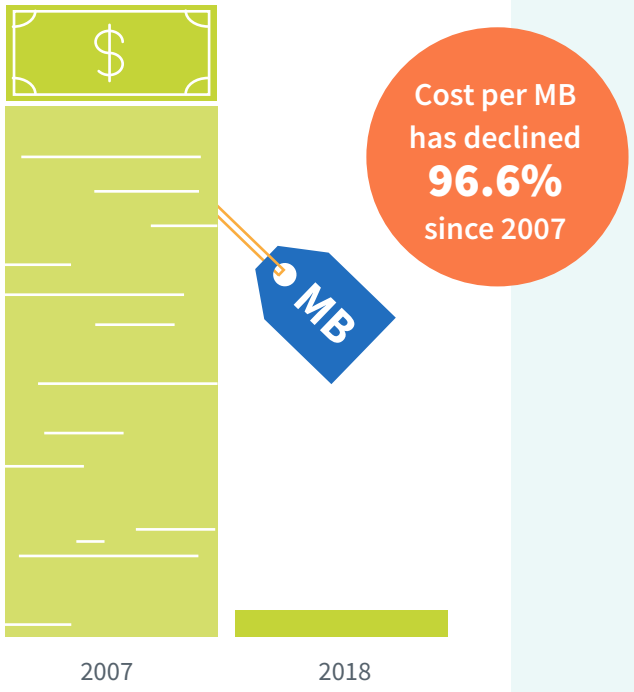
Tireless innovation yields better products and services.

Today, we can pick from hundreds of handsets, multiple operating systems, millions of apps and services, and nearly 700 different smartphone plans.

Our wireless speeds keep getting faster. **Today's 4G mobile data speeds are more than 38 times 3G speeds a decade ago**, and today's average download speed—22.69 Mbps—is a 60% increase from 2014. Next-generation 5G networks will be even faster.



As wireless use continues to grow, we keep delivering more value. In fact, last year, the average price for a set of core consumer goods fell for the first time since January 2010, all thanks to declining price of wireless service.[14]



From energy and transportation to public safety and health care, wireless connectivity is enabling dynamic new services and applications that improve—and save—lives.

> *In 2018, we have remote examinations and devices that can wireless connect patient with their providers … giving patients timely and convenient access to health services. This improves chronic disease management, reduces the burdening costs of transportation and … decreases hospital readmissions.*

—Dr. Rheuban, Medical Director,
UVA Center for Telehealth

Wireless Powers the U.S. Economy

Wireless plays a pivotal role in driving our economy today. The wireless industry contributes

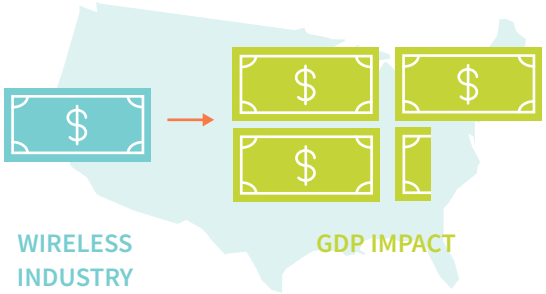
$475B

to the U.S. economy annually, **2.6%** of 2016 U.S. GDP.

That makes the U.S. wireless industry the **24th largest** economy in the world[15]

From our direct impact to our indirect contributions, wireless is an economic accelerator.

Every dollar of the wireless industry's direct GDP contribution generates $3.20 of total GDP impact across the broader economy.



The wireless industry's contribution to the U.S. economy trumps others'.

3x

3x that of the agriculture, forestry, fishing, and hunting industries

4x

Almost 4x the motion picture and sound recording industries

4.5x

Almost 4.5x the air transportation industry

An entire ecosystem of jobs is built on the foundation of wireless networks. From tower techs and network architects to customer service representatives and accountants, wireless providers employ people in all corners of the country to provide world-class service.

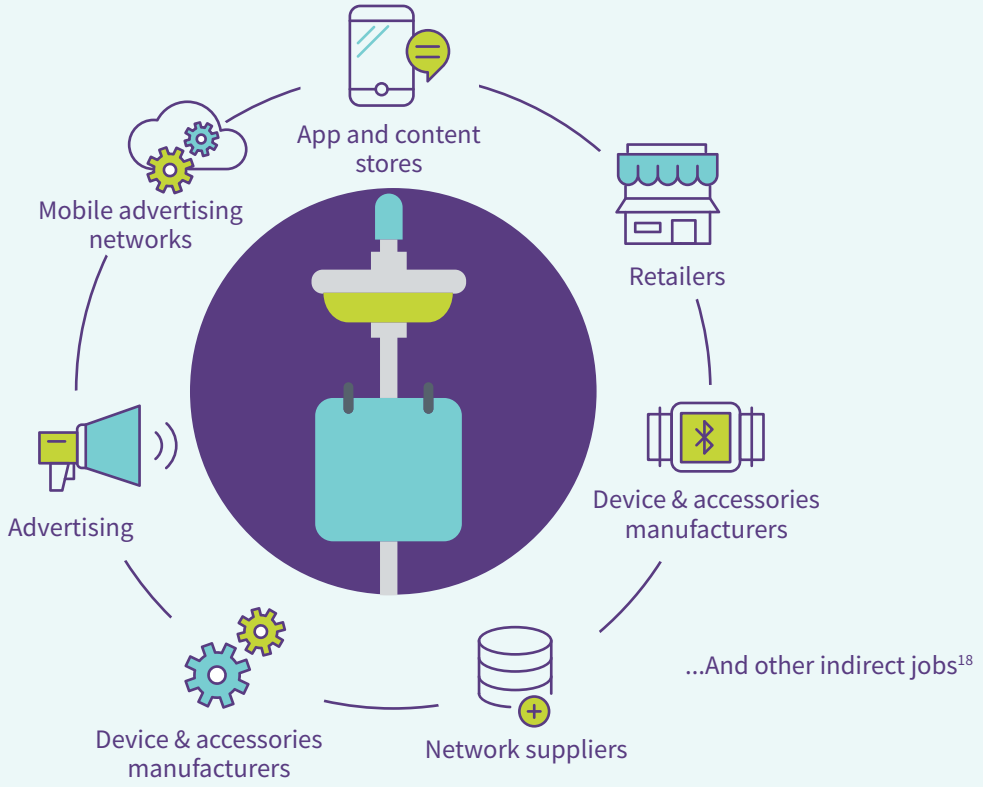
In 2017, wireless providers alone directly employed 207,324 people across the country.

These wireless jobs are good jobs with good salaries.

Wireless employee wages are 50% higher than the average wage.[16]

THE WIRELESS INDUSTRY IS A JOBS MULTIPLIER.

Every wireless job creates an additional 7.7 jobs throughout the broader economy[17], ultimately supporting 4.7 million U.S. jobs across ecosystem sectors.



Unleashing the Power of Next-Generation 5G Networks

Wireless is always growing, innovating, and driving the economy. Now with 5G, new cycles of innovation and investment are poised to further transform the mobile ecosystem, our way of life, and our economy.

5G BENEFITS

$275B
in investment

3M
new jobs

$500B
in economic growth[19]

Building out the wireless networks of tomorrow

The wireless industry is deploying more cell sites in more places to further extend coverage and prepare for the next generation of wireless, 5G.

A record 323,448 cell sites were in operation at the end of 2017.

+52%
in the last ten years

This number is poised to increase dramatically as the wireless industry installs more small cells—small-scale antennas and powering equipment that can be deployed on street lights, utility poles, or the sides of buildings—to densify 4G networks and provide the bedrock for 5G networks.

The number of small cells deployed is predicted to rapidly increase over the next few years from about 13,000 small cells in 2017 to 86,000 this year—a 550% increase—and over 800,000 by 2026.

This increase underscores the importance of every level of government modernizing its wireless infrastructure rules.

+550%
increase in 2018

Preparing for 5G

America's wireless providers and equipment vendors have conducted dozens of 5G trials across the country. Thanks to those trials and industry investment in the technology and people that will enable 5G, the U.S. will begin to see this next generation as early as this year.

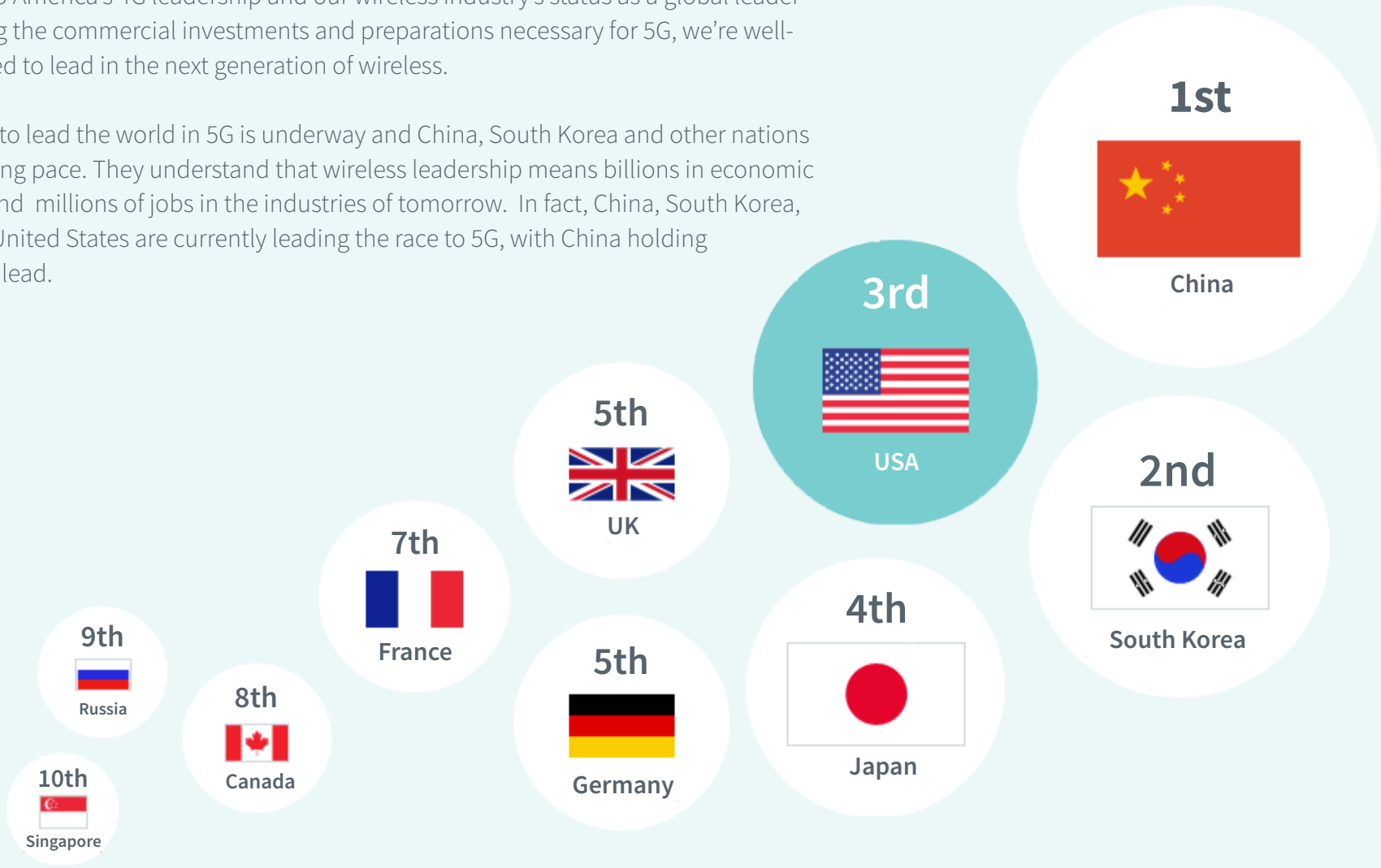
Driven by intense competition, all national wireless providers have revealed 5G deployment plans with new announcements happening all the time. Communities across the country will soon see the beginning of 5G networks.

5G will be deployed in at least **30 markets** by early 2019

Winning the Race to 5G

Thanks to America's 4G leadership and our wireless industry's status as a global leader in making the commercial investments and preparations necessary for 5G, we're well-positioned to lead in the next generation of wireless.

The race to lead the world in 5G is underway and China, South Korea and other nations are keeping pace. They understand that wireless leadership means billions in economic growth and millions of jobs in the industries of tomorrow. In fact, China, South Korea, and the United States are currently leading the race to 5G, with China holding a narrow lead.



There are real and significant advantages to maintaining global wireless leadership. America's 4G leadership resulted in economic and job growth that would have otherwise gone to other countries.

Just as winning the race to 4G required smart government policies, winning the race to 5G will require swift action on pending legislation and regulatory reforms, including setting a clear schedule of future spectrum auctions and modernizing infrastructure siting rules.

We are confident with the significant industry investment ongoing and the important pending reforms before policymakers, the U.S. is positioned to lead the world again in 5G.

4G LEADERSHIP-DRIVEN ECONOMIC BENEFITS[20]

$125B

in revenue to American companies

$100B

GDP increase

84%

increase in wireless-related jobs

Sources

[1] http://www.pewinternet.org/fact-sheet/mobile/

[2] http://www.pewinternet.org/fact-sheet/mobile/

[3] http://www.pewinternet.org/2011/07/11/overview-of-smartphone-adoption/

[4] Morning Consult survey: nationwide poll of 2,035 registered voters between Dec 19 and Dec 21, 2017

[5] CTIA 2017 Harris Poll 5G Executive Survey. The study was conducted August 3-21, 2017, online by Harris Poll on behalf of CTIA among 507 executives in the U.S. working in the healthcare, transportation, energy, and manufacturing industries.

[6] https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201712.pdf

[7] http://www.pewinternet.org/fact-sheet/mobile/

[8] http://www.pewinternet.org/fact-sheet/mobile/

[9] http://www.pewinternet.org/fact-sheet/mobile/

[10] Morning Consult survey: nationwide poll of 1,991 registered voters between Jan 30 and Feb 1, 2018

[11] https://www.fiercewireless.com/iot/90-industry-s-net-adds-now-coming-from-connected-cars-iot-chetan-sharma

[12] https://apps.fcc.gov/edocs_public/attachmatch/DOC-349145A1.pdf (p.48)

[13] https://us-fcc.app.box.com/s/uoh8tfrnzwhehw88lk5ojd3o7yldchj0

[14] https://www.ctia.org/news/getting-more-for-less-how-wireless-competition-and-unlimited-data-help- america-s-economy

[15] https://www.ctia.org/news/how-the-wireless-industry-powers-the-u-s-economy

[16] https://www.bls.gov/data/#employment

[17] https://www.ctia.org/news/how-the-wireless-industry-powers-the-u-s-economy

[18] https://www.ctia.org/news/how-the-wireless-industry-powers-the-u-s-economy

[19] https://www.ctia.org/docs/default-source/default-document-library/how-5g-can-help-municipalities-become-vibrant-smart-cities-accenture.pdf

[20] https://api.ctia.org/wp-content/uploads/2018/04/Race-to-5G-Report.pdf (page 4)

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Appendix B

Background on CTIA's Wireless Industry Survey

CTIA's wireless industry survey develops industry-wide information drawn from operational member and non-member wireless service providers. It has been conducted since January 1985, originally as a cellular-only survey instrument, and now including the community of CMRS licensees (e.g., PCS, ESMR, AWS, BRS and 700 MHz license holders). No break-out of results specific to spectrum bands or licenses is performed. From January 1985 through December 2012, it was conducted as a semi-annual survey, and it is now conducted on an annual basis.

The information determined based on the survey includes: direct employment, number of cell sites, total service revenues, the average revenue per unit (ARPU), and various measures of usage (e.g., minutes and megabytes). The ARPU figure is not equal to the average monthly bill, which may reflect provision of service to multiple devices on a single account.

CTIA's survey develops information on the number of reported wireless service subscribers or connections for the responding systems, and an estimated total connections figure (taking into account non-responding systems). Because CTIA's survey is a voluntary survey, it cannot compel responses from wireless carriers. However, the survey has an excellent response rate. For the December 31, 2017, installment of the survey, CTIA aggregated data from companies serving 97.9 percent of all estimated wireless subscriber connections (excluding some machine-to-machine and other units not treated as subscriber connections for reporting purposes by some carriers).

Because not all systems do respond, CTIA develops an estimate of total wireless connections. The estimate is developed by determining the identity and character of non-respondents and their markets (e.g., RSA/MSA or equivalent-market designation, age of system, market population), and using surrogate penetration and growth rates applicable to similar, known systems to derive probable subscribership. These numbers are then summed with the reported subscriber connection numbers to reach the total estimated figures. No carrier-specific or market-specific information is maintained as a result of the survey. All such information is aggregated by an independent accounting firm to a nationwide level. The underlying source material for the survey is then destroyed per confidentiality agreements.

The following tables and charts reflect selected top-of-the-line data. Complete results of CTIA's survey are available for purchase in the comprehensive report, **CTIA's Wireless Industry Indices: 1985 – 2017**, including data on revenues, subscriber usage, investment, and other operational indicators and ratios.

The report is available for a member price of $850 and a non-member price of $1,075. Subsequent copies are available to members at $475 each and to non-members at $535 each. Two year subscriptions are available at a member price of $1,445 and non-member price of $1,825.

To order this report contact research@ctia.org or order online at store.ctia.org

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CTIA annualized wireless industry survey results – 2001 to 2017

Date	Estimated Total Subscriber Connections	Annual Services Revenues ($000s)	Cumulative CapEx ($000s)	Cell Sites	Direct Carrier Employees	Monthly Average Revenue Per Unit
2001	128,374,512	$65,316,235	$105,030,101	127,540	203,580	$49.79
2002	140,766,842	$76,508,186	$126,922,347	139,338	192,410	$51.00
2003	158,721,981	$87,624,093	$145,866,914	162,986	205,629	$51.55
2004	182,140,362	$102,121,210	$173,793,507	175,725	226,016	$52.54
2005	207,896,198	$113,538,220	$199,025,327	183,689	233,067	$50.65
2006	233,040,781	$125,456,825	$223,158,248	195,613	253,893	$49.07
2007	255,395,599	$138,869,304	$244,591,206	213,299	266,782	$49.26
2008	270,333,881	$148,084,170	$264,760,517	242,130	268,528	$48.87
2009	285,646,191	$152,551,854	$285,121,591	247,081	249,247	$47.97
2010	296,285,629	$159,929,649	$310,014,851	253,086	250,393	$47.53
2011	315,963,848	$169,767,314	$335,331,967	283,385	238,071	$46.11
2012	326,475,248	$185,013,935	$365,426,326	301,779	230,101	$48.99
2013	335,652,171	$189,192,812	$398,567,671	304,360	230,409	$48.79
2014	355,445,472	$187,848,447	$430,642,374	298,055	232,169	$46.64
2015	377,921,241	$191,949,025	$462,605,007	307,626	235,818	$44.65
2016	395,881,497	$188,524,256	$488,996,535	308,334	216,537	$41.50
2017	400,205,829	$179,091,135	$514,625,256	323,448	207,324	$38.66

Cumulative Capital Investment Exceeded **$514 Billion** at Year-end 2017

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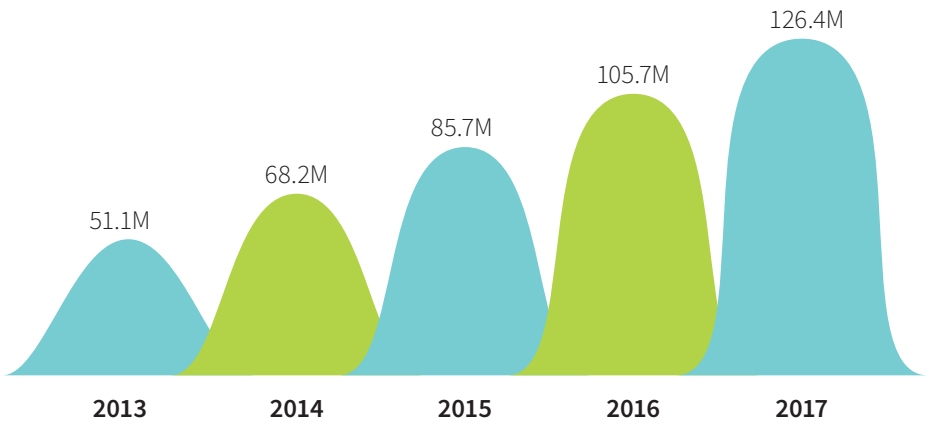
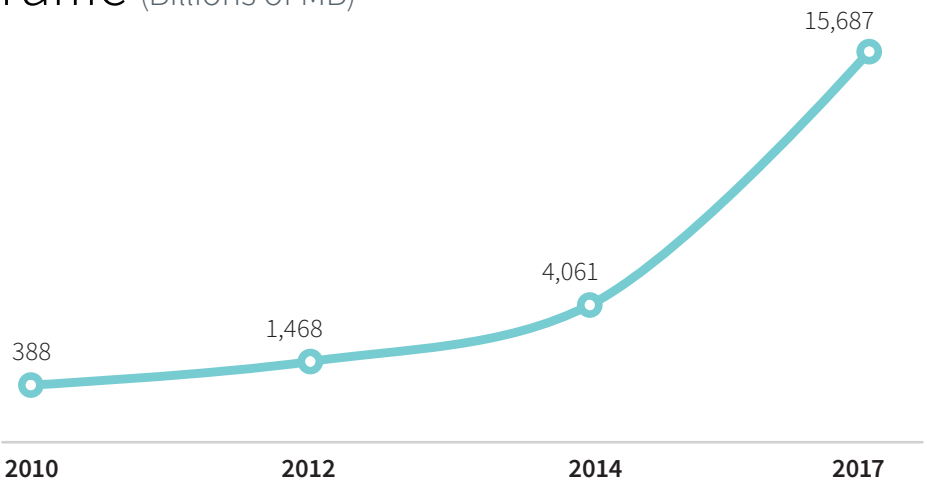
Data-Only Devices (Millions)



Data-Only Devices Grew **147%** Since 2013

Reported Wireless Data Traffic (Billions of MB)



Reported Annual Wireless Data Traffic Grew **40** Times Since 2010,
Up **4x** from 2014

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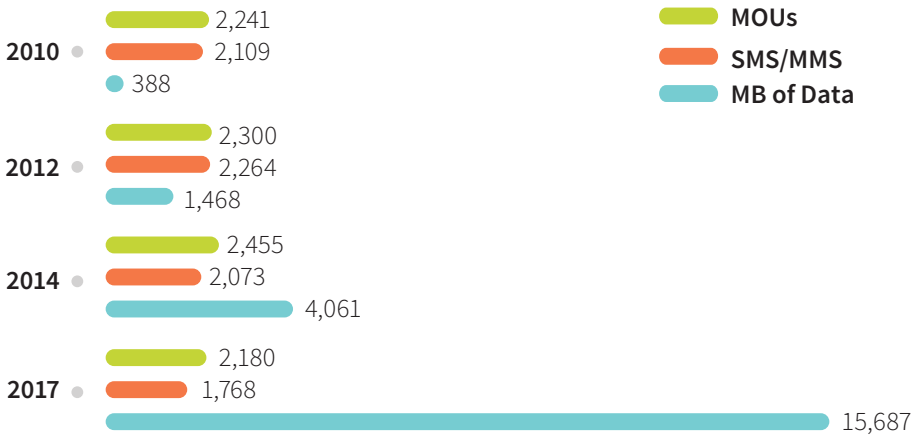
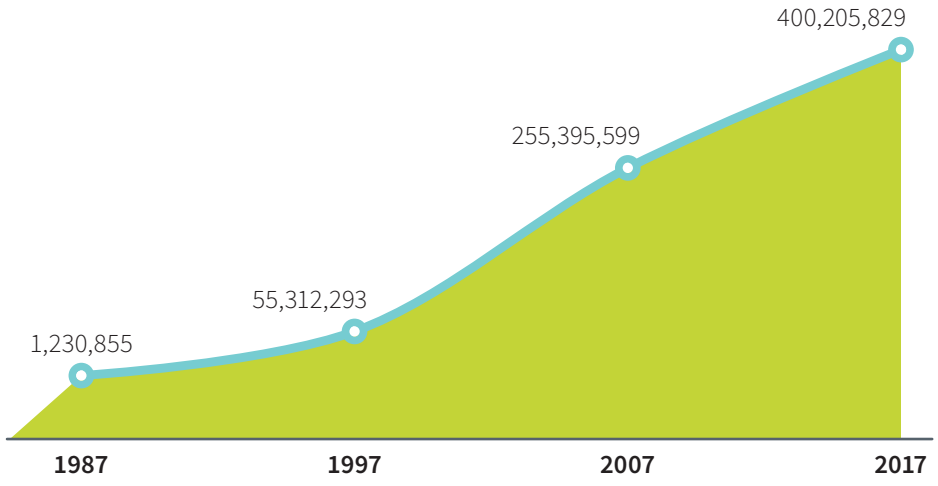
Annual minutes, messages and megabytes of wireless traffic (Billions of MOUs/Messages/MB)



The Mix of Minutes, Messages and MBs Changes – Data Dominates

Estimated Wireless Subscriber Connections



Estimated Connections Equal **120.7%** of U.S. Population

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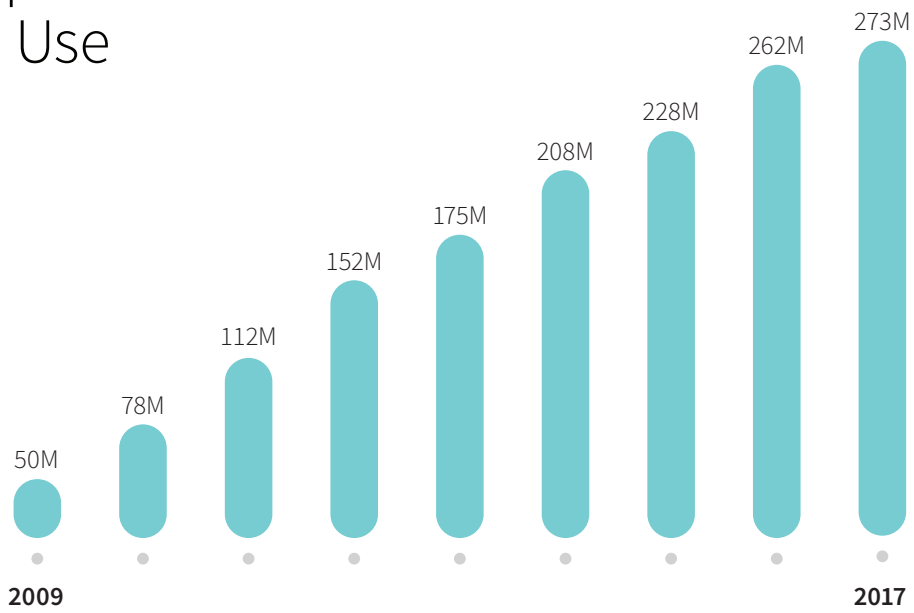
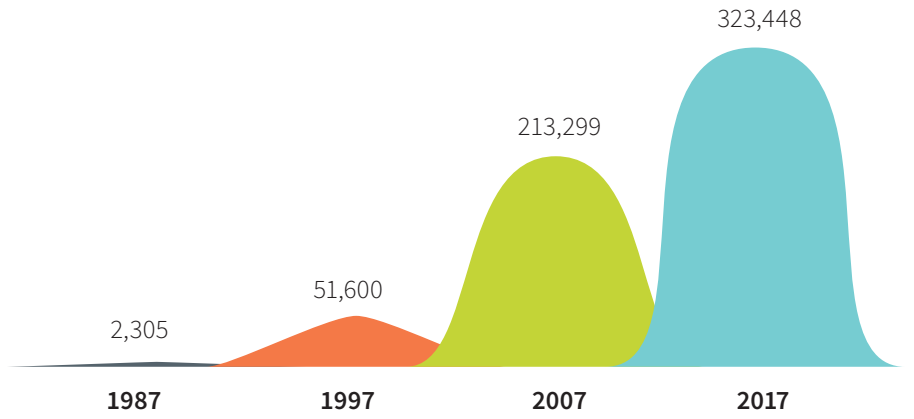
Smartphones in Active Use



Reported Smartphones Grew **5.5x** from 2009

Cell Sites in Service



A Record **323,448** Cells Sites Were in Operation in 2017,
Representing **52% Growth** Over the Last Decade

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